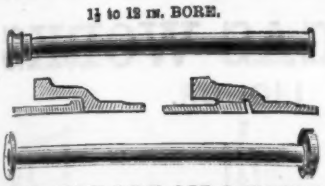
THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LVII. No. 1462.] LONDON, MAY 19, 1891. [43RD YEAR. Price 6d.

GAS AND WATER PIPES.

1¼ to 12 IN. BORE.



THOMAS ALLAN & SONS,

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SOUTH STOCKTON-ON-TEES.

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SANITARY & RAIN-WATER PIPES, HOT WATER PIPES STABLE FITTINGS, RANGES, STOVES, And GENERAL CASTINGS.

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— ESTABLISHED 1830. —

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PATENT ANTIMONY PAINT,

Parker's Imperial Black Varnish,

Oxide Paints, Oils, and General Stores for Gas and Water Works.

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TORBAY PAINTS

Special Quotations to Gas Companies.

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Portland Cement

MANUFACTURED BY

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STOREAGE CAPACITY 10,000 Tons.

ESTABLISHED 1811—OVER THREE QUARTERS OF A CENTURY.

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Capable of withstanding Greater Heat than that adequate to the Fusion of Iron.

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The Highest Testimonials and References from Eminent Authorities, at home and abroad, in support of the foregoing statements.

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THE COST OF PURIFICATION REDUCED

to a minimum by

C. & W. WALKER'S

PATENT PURIFYING MACHINE,

Which has now fully proved itself to be the most effectual, powerful, and perfect Apparatus in the World,

FOR PURIFYING GAS FROM

TAR, CARBONIC ACID, AMMONIA,

and a large portion of

SULPHURETTED HYDROGEN,

Doing all the work of Purification between the Condensers and Purifiers, and relieving them of much work.
Its cost is less than any other known Apparatus for purifying Gas from Tar and Ammonia.

Testimonials, Drawings, and Prices on Application.

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IMPROVED CONSUMERS' WET GAS-METERS

IN CAST-IRON CASES,

THE UNVARYING WATER-LINE GAS-METER,

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IMPROVED DRY GAS-METERS;

Also Sole Makers of THORP AND MARSH'S PATENT CASH PREPAYMENT ATTACHMENT FOR GAS-METERS.

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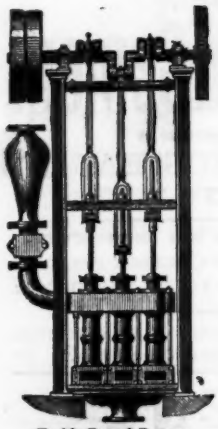
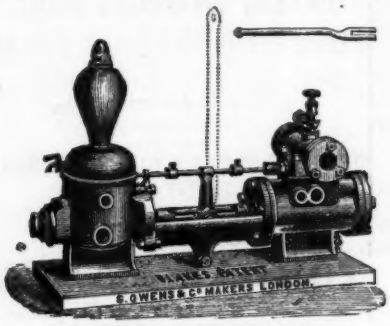
FOR PUMPING TAR, WATER, AND LIQUOR.



Treble-Barrel Pumps in Frame.

Syphon Pump.

Double-Barrel Force-Pump in Frame.



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STEAM PUMPS.
20,000 IN USE.

Improved Double Action Pump.

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Wrought-Iron Portable Pump.

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WITH RACK & PINION,
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SCREWS, of all Sizes.
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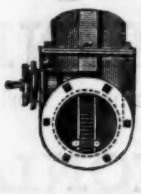

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RETORT-BED FITTINGS,
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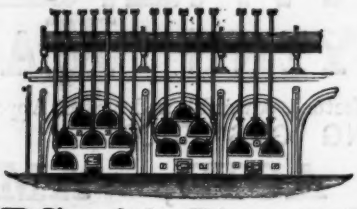
Iron Roofs, Columns, Girders, Floor Plates and Tools, &c.



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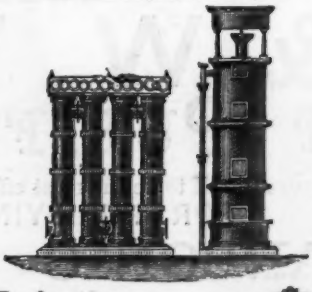
SCRUBBERS, & WASHERS,
TAR AND LIQUOR PUMPS, &c.



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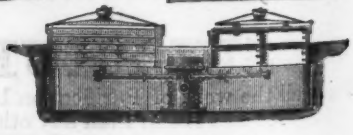
CENTRE VALVES
for working Purifiers.
Also Bye-Pass & Stop Valves.

PURIFIERS with Planed Joints,
HAND and HYDRAULIC LIFTING GEAR, CAST-IRON MAINS and SPECIALS,
WOOD GRIDS.
CAST AND WROUGHT IRON TANKS AND CISTERNS.



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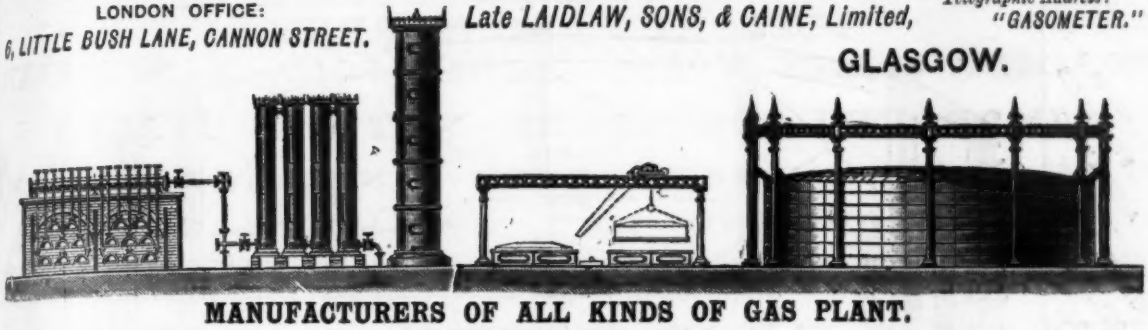

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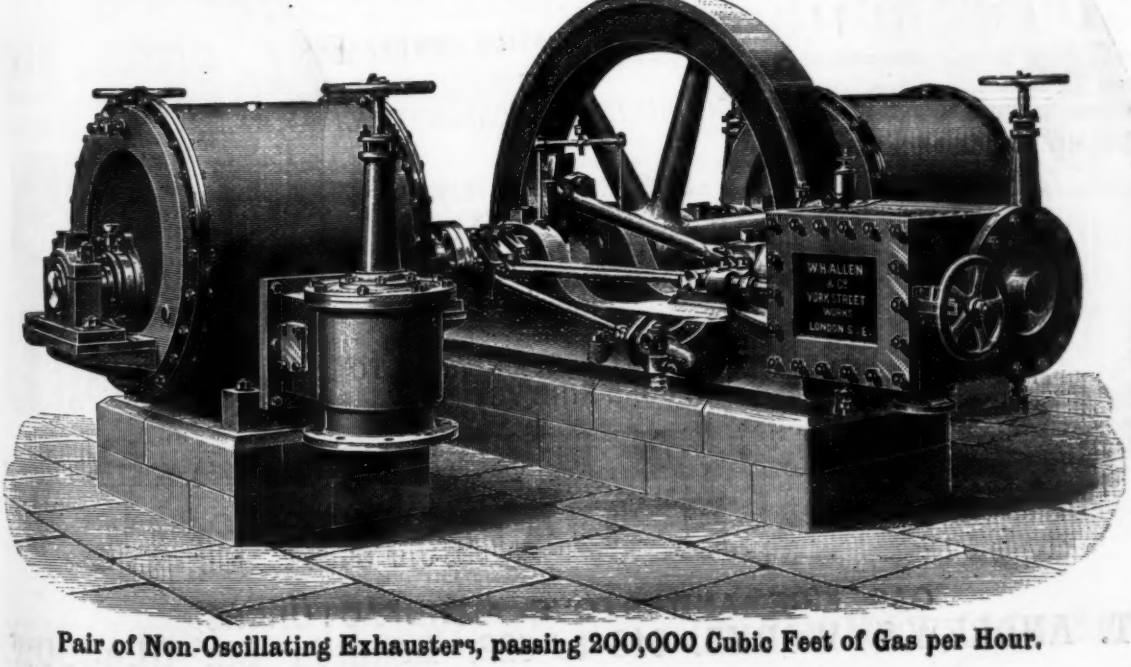
BEALE'S PATENT—ALLEN'S COMBINED SYSTEM.



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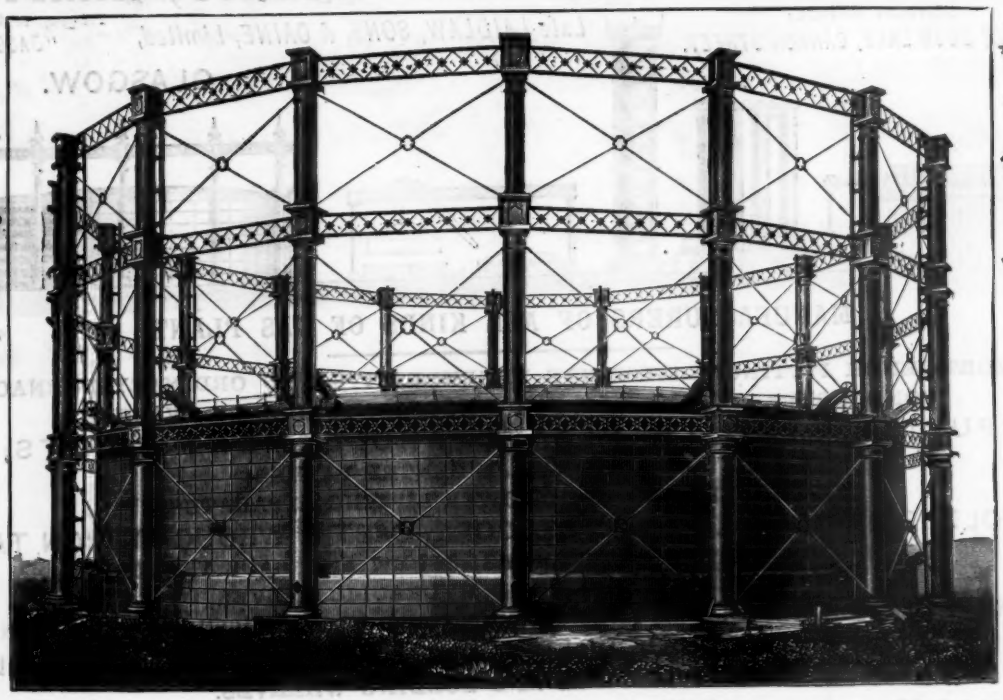

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BECKTON.	BRADFORD.	CARDIFF.	LEEDS.	NOTTINGHAM.	RIO GRANDE.	SYDNEY.
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THE 'DARWIN' GAS-FIRE.

A NEW DEPARTURE IN GAS-FIRES.

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DIMINISHED GAS CONSUMPTION.

SURPASSING ALL PREVIOUS ATTAINMENTS.

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NEAREST RESEMBLANCE TO A COAL FIRE YET MADE.

"THE DARWIN"
No. 105 Y.
SIZES—15in. WIDE, 6½in. DEEP, 20in. HIGH.
PRICE 25s. EACH, BEST BERLIN BLACKED.
ELECTRO-BRONZED or BRASSED, 8s. 6d. each extra.

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SIZES—15in. WIDE, 6½ in. DEEP, 20in. HIGH.
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GAS FIRE AND STOVE MANUFACTURERS,

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JOSEPH CLIFF & SONS,

INCORPORATED IN
THE LEEDS FIRE-CLAY COMPANY, Ltd.,
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Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

RETORTS CAREFULLY PACKED FOR EXPORT.

Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

ESTABLISHED MORE THAN A QUARTER OF A CENTURY

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CLAYTON SON & CO. LTD.

MAKE A

SPECIALTY
OF
GASHOLDERS

AND
MAKERS
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"GAS LEEDS"

GAS PLANT OF EVERY DESCRIPTION.

R. & J. DEMPSTER,

GAS PLANT WORKS, NEWTON HEATH, MANCHESTER,

MAKERS AND ERECTORS OF

PATENT COLUMNLESS GASHOLDERS.

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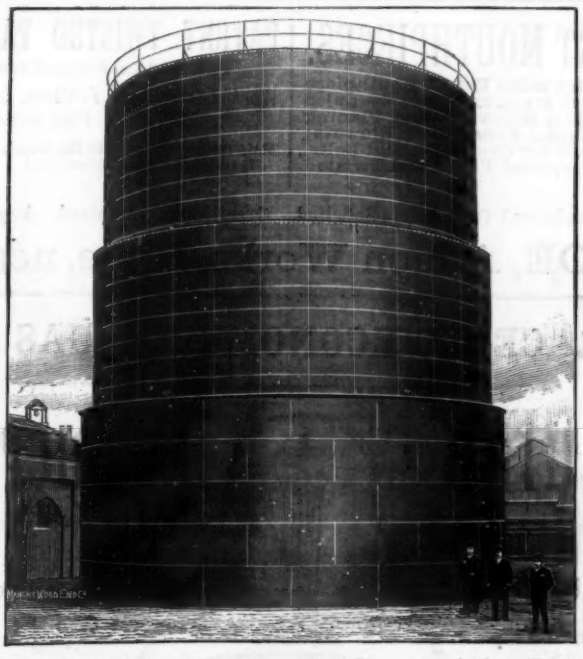
TOTAL WEIGHT REDUCED
from 30 per cent. to 50 per cent.

TRANSPORT AND ERECTION REDUCED
to the same extent; and in cases where gasholders are shipped abroad to places difficult of access, this represents a very large amount of money.

TANK CONSTRUCTION SIMPLIFIED.
The Tank wall (of whatever construction) is a regular cylinder. There are no piers needed, and all expensive foundation stones for the base of columns or standards are dispensed with.



Two-Lift Gasholder recently erected, in a wrought-iron Tank, for the Birmingham Oxygen Company, at their Works, Saltley, Birmingham. The bottom of the Tank is fixed level with the ground, upon a concrete foundation.

COST OF PAINTING SAVED
for the Columns and Girders.

TILTING UTTERLY IMPOSSIBLE;
And as there are fewer parts, there is less liability for the Gasholder to get out of order in working.

STABILITY UNDER WIND PRESSURE
of a Gasholder constructed upon this system is at least equal to, and from experiments and calculations made is far in excess of, that of a Holder of the same dimensions guided by the elaborate guide framing at present in use

The removal of heavy guide carriages and rollers from the top curbs considerably lowers the centre of gravity of the structure, and dispenses with the extra strength of sheeting necessary to carry these at the points where they are attached to the gasholder.

The plan adapts itself to telescoping to any reasonable extent, and enables very shallow holders or lifts to be employed with perfect stability.

FOR FURTHER PARTICULARS AND ESTIMATES, APPLY TO THE ABOVE.

JOHN HALL & CO.,

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MANUFACTURERS OF FIRE-BRICKS, LUMPS, TILES,

AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.

RETORTS CAREFULLY PACKED FOR SHIPMENT.

A STOCK OF DIFFERENT SHAPES ON HAND.

GAS AND WATER PIPES

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CASTINGS OF EVERY DESCRIPTION.

MANUFACTURED BY THE

CLAY CROSS COMPANY,

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SULPHATE OF AMMONIA.

By Her Majesty's Royal Letters Patent.

DR. FELDMANN'S APPARATUS

The most successful and approved Apparatus known up to the present time.

FOR REFERENCES, PARTICULARS, TESTIMONIALS, AND PRICES APPLY TO THE

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The Apparatus has been supplied to the following Firms—

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JOHN RUSCOE calls attention to his Retort Mouthpiece and Lid Facing Machines, which are in extensive use; also to his Lathes, Drilling, Slotting, Grooving, and Planing Machines, Smiths' Hearths, Smithy Fans, Roots' Blowers; also special Screwing Machines for Gas Tubes and Bolts, Taps, Wrenches, Pipe Cutters, special Taper and Twisted Rymers, Drills, &c.

PATENT TWISTED TAPS, DIES, & CUTTERS.

Thousands in constant work, give universal satisfaction.

Work Easier, Less Friction, Last Longer, and do Better Work than straight Grooves.

Main Drilling Stand, with Cup Drills, 1¼ to 6 inch; Taps, Rymers, and Drills.

Ratchet Screwing Stocks, and Adjustable Once-up Stocks, Dies, Guides, &c.

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The Schülke Regenerative Lamp

FOR

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The only Regenerative Lamp employing the Common Flat-Flame Burners.

Lamps giving 20-Candle power consume less than four feet of Gas per hour.

PURE WHITE & PERFECTLY STEADY LIGHT,

NOT AFFECTED BY DRAUGHTS.

Suitable for any existing fittings (Brackets or Suspending).

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Where Price Lists and full particulars may be obtained.

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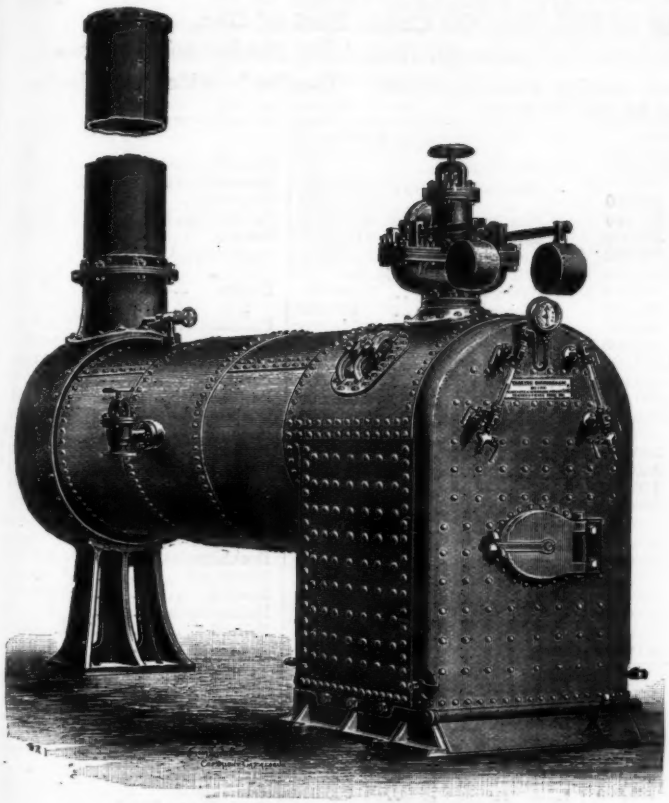
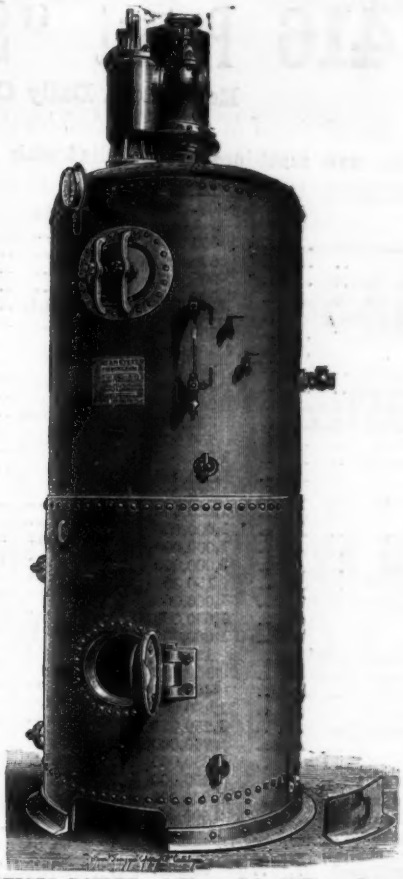
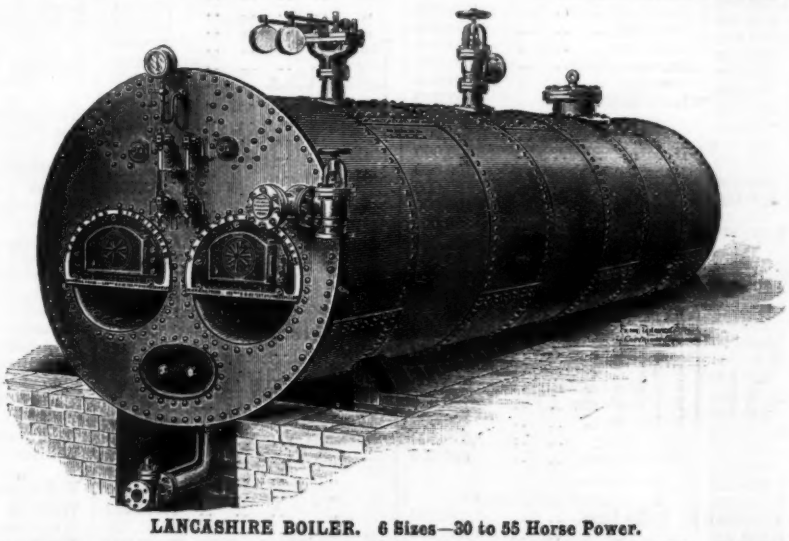


"LOCO." BOILER. 12 Sizes—6 to 40 Horse Power.



VERTICAL BOILER. 7 Sizes—3 to 14 Horse Power.



LANCASHIRE BOILER. 6 Sizes—30 to 55 Horse Power.

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No. 71 E.

KIRKHAM, HULETT, & CHANDLER, LIMITED.

[Mr. SIDNEY HERSEY, Managing Director.] ADDRESS AT FOOT. [Mr. J. CHANDLER, Engineer.]

416 Patent "Standard" Washer-Scrubbers,

Equal to a Daily Capacity of 374,700,000 Cubic Feet of Gas,

Erected and in course of construction at present date, amongst them being the following, viz.:—

(All new machines are supplied with improved wooden washing devices—"Bundles"—which can also be fitted to old Washers)

	Capacity. Cubic feet per day.
Altrincham	600,000
Adelaide	600,000
Aldershot	200,000
Allegheny, U.S.A.	1,000,000
Ashton-under-Lyne	1,250,000
Amsterdam	1,500,000
"	1,500,000
Annaberg	200,000
Arcachon	100,000
Animal Charcoal Co.	200,000
Altoona, U.S.A.	350,000
Buxton	250,000
Bradford	1,000,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,000,000
"	1,000,000
"	3,000,000
Bremen	150,000
Baltimore, U.S.A.	1,000,000
"	1,000,000
"	1,000,000
Balmain, N.S.W.	125,000
Bishops Stortford	150,000
Blackpool	400,000
Brussels	1,250,000
"	1,250,000
"	750,000
"	1,250,000
Banbury	250,000
Birmingham	5,000,000
Birkenhead	2,500,000
Blackburn	1,500,000
Bochum	600,000
Burntisland	250,000
Boston, U.S.A.	2,000,000
Brisbane	1,500,000
"	300,000
Burton-on-Trent	1,500,000
Barcelona	350,000
Barking	100,000
Baerlien & Co.	20,000
"	420,000
Bombay	700,000
Buffalo, U.S.A.	550,000
"	500,000
Brooklim, U.S.A.	300,000
Bergen	250,000
Berlin	150,000
Bournemouth	1,000,000
Bridgeport, U.S.A.	500,000
Brunswick	300,000
Beck & Co., St. Louis	100,000
Barmen Rittershausen	600,000
Bexhill	125,000
Brooklyn, U.S.A.	1,000,000
"	1,000,000
Brunner, Mond, & Co.	400,000
Cheltenham	2,000,000
Cannes	200,000
Croydon	1,500,000
Copenhagen	200,000
Clevedon	200,000
Columbus, U.S.A.	500,000
Cincinnati, U.S.A.	1,500,000
"	1,500,000
Chicago, U.S.A.	3,000,000
"	1,000,000
"	1,000,000
Chemnitz	1,000,000
Crewe	1,250,000
Colonial Gas-Works Co.	100,000
Cadiz	300,000
Charottenberg	600,000
Dudley	750,000
Driffield	100,000
Dukinfield	500,000
Dover	750,000
"	1,000,000
Deal	200,000
Derby	1,500,000
Dublin	3,000,000
Dowlais	100,000
Douai	500,000
Denton	500,000
Derby, U.S.A.	350,000
Denver, "	500,000
" "	1,000,000
Düsselldorf	750,000
"	500,000
Dumfries	250,000
Dunedin, N.Z.	400,000
Darlington	1,250,000
Detroit, U.S.A.	750,000
Edinburgh	1,500,000
"	2,000,000
Enfield	300,000
Essen	300,000
Elbing	150,000
Falmouth	150,000
Frankfort	300,000
Farnworth	400,000
Fenton	400,000
Friedenshütte	500,000
Fürth	400,000
Freiburg	200,000
Goole	250,000
Glossop	300,000
Guildford	300,000
Gloucester	1,250,000
Gera	300,000
Grafton, N.S.W.	100,000
Grieg	300,000
Georgetown, U.S.A.	250,000
Gluckauf	200,000
Heywood	600,000
Holywood	125,000
Huy	70,000
Harrow	250,000
Harrogate	250,000
Halstead	150,000
Heilbronn	200,000
Havanna, Cuba	750,000
Hastings	1,500,000
Huddersfield	300,000
"	750,000
"	1,500,000
Hof	200,000
Hampton Wick	500,000
Heckmondwike	500,000
Haverfordwest	100,000
Halifax, N.S.	350,000
Hamm	200,000
Halle	400,000
Heidelberg	300,000
Hartford, U.S.A.	1,000,000
Ilkeston	300,000
Inverness	250,000
Ilkley	200,000
Ilford	100,000
Kingston-on-Hull	400,000
Kidderminster	750,000
Kidsgrove	100,000
Königsberg	1,000,000
King's Lynn	300,000
LONDON:—	
The Gaslight and Coke Co.:—	
Beckton	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	2,500,000
"	2,500,000
Silvertown	1,000,000
Bromley	2,000,000
"	1,500,000
"	1,500,000
"	1,500,000
"	2,000,000
"	1,500,000
Shoreditch	2,500,000
LONDON—*Continued.*	
Pancras	1,500,000
"	1,500,000
Pimlico	2,000,000
Nine Elms (2)	3,000,000
Kensal Green (2)	3,000,000
South Metropolitan Co.:—	
Greenwich	3,000,000
Woolwich	400,000
Vauxhall	3,000,000
"	3,000,000
Lea Bridge	300,000
West Ham	1,500,000
"	3,000,000
Leeds	2,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	2,000,000
Leominster	150,000
Leiden	560,000
"	600,000
Liverpool	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
" (3)	3,000,000
Lincoln	1,000,000
"	600,000
Lowell, U.S.A.	1,000,000
Laclede, "	1,000,000
Louisville, "	1,500,000
Long Eaton	500,000
Lille	900,000
"	450,000
"	750,000
"	250,000
"	250,000
Luckenwalde	330,000
Liegwitz	300,000
Lincoln, U.S.A.	250,000
Lawrence, "	500,000
Lynn, "	300,000
Lyons	1,500,000
Maidstone	1,000,000
Marseilles	1,500,000
"	1,500,000
Mons	500,000
Malines	250,000
Melbourne	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
Manchester	2,500,000
Middleton	400,000
Manley, N.S.W.	100,000
Minneapolis, U.S.A.	750,000
Magdeburg	300,000
Memphis, U.S.A.	750,000
Nottingham	1,250,000
"	2,500,000
"	2,500,000
"	2,000,000
"	1,500,000
"	2,000,000
Newport, U.S.A.	430,000
Newmarket	150,000
Newark, U.S.A.	680,000
Northfleet	200,000
New York, U.S.A.	2,000,000
Nice	600,000
Newcastle, N.S.W.	200,000
Numea, "	100,000
Namur	250,000
Newark	350,000
Nassau, U.S.A.	1,000,000
Oldbury	500,000
Otley	200,000
Oswestry	250,000
Ober Schlesian	1,500,000
Otto & Co.'s Coke Works	1,500,000
Plymouth	2,000,000
Parramatta, N.S.W.	100,000
Prescot	150,000
Providence, U.S.A.	750,000
" "	750,000
Plauen	300,000
"	300,000
Portsmouth	2,500,000
"	2,500,000
Pittsburg, U.S.A.	1,500,000
Portland, "	560,000
Pawtucket "	500,000
Quebec	250,000
Radcliffe	750,000
Rouen	250,000
Ramsgate	1,000,000
Reigate	200,000
Richmond, U.S.A.	250,000
Roxbury, "	500,000
Runcorn Soap Co.	20,000
Rockhampton, N.S.W.	125,000
Richmond	1,500,000
Reading	2,000,000
Reichenbach	200,000
Salford	1,750,000
"	1,750,000
"	1,750,000
Smethwick	750,000
Sydney, N.S.W.	1,000,000
"	1,000,000
"	2,500,000
"	50,000
"	50,000
Sunderland	1,500,000
St. Joseph's, U.S.A.	250,000
Spa	100,000
Sevenoaks	300,000
St. Petersburg	2,000,000
"	1,500,000
St. Louis, U.S.A.	2,000,000
"	2,000,000
"	1,000,000
Silesian Coal Co.	600,000
San Francisco, U.S.A.	2,000,000
"	2,000,000
Sheepbridge Coal Co.	40,000
Stettin	200,000
Singapore	300,000
Sutton	500,000
Tonbridge	150,000
Tipton	400,000
Tottenham	1,000,000
Toledo, U.S.A.	750,000
Toronto	1,000,000
Uxbridge	300,000
Valparaiso	500,000
West Bromwich	1,000,000
Willenhall	250,000
Weston-super-Mare	500,000
Waltham	150,000
Wormwood Scrubbs	300,000
Williamsburg, U.S.A.	600,000
" "	600,000
Wellington	150,000
Warwick	300,000
Wheeling, U.S.A.	500,000
Walker	300,000
Westgate	100,000
Wilmington, U.S.A.	500,000
Windsor, N.S.W.	100,000
Wolverton	100,000
Wellington, N.Z.	250,000
Whitchurch	175,000
Washington, U.S.A.	2,000,000
Wallasey	750,000
Weimar	150,000
Wurzen	200,000
Worcester, U.S.A.	750,000
Yeadon	500,000
Yeovil	250,000

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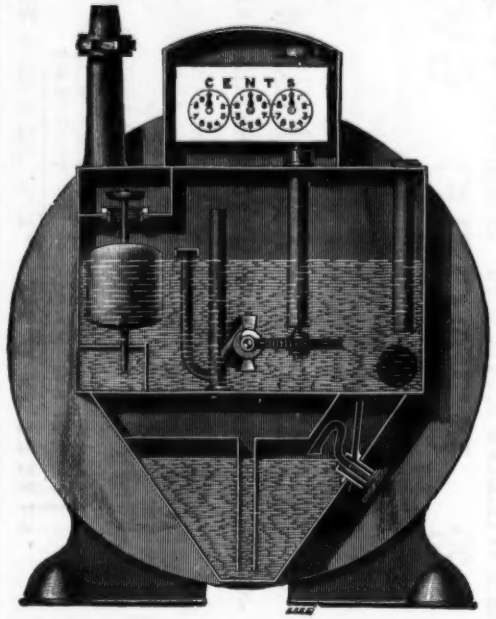
THE SYPHON OVERFLOW

— Wm. Cowan's Patent. —



To suppose, as some do, that the main object of the "Syphon Overflow" is to promote the convenience of inspectors and others who "water" meters, is to misapprehend the chief purpose of the invention. That the convenience of inspectors is promoted by the Syphon Overflow is a fact that admits of no doubt whatever, because the watering of meters is thereby greatly facilitated; but it is a mistake to fix attention upon this result, and to regard it as the only one attained. To do this is to lose sight of the chief purposes the Syphon Overflow was designed to secure.

These purposes were—

1st.—The **speedy** attainment of **exactly the same water line** on each occasion of watering.

2nd.—The **absolute certainty** of this water line being attained.

3rd.—The **impossibility** of any water afterwards finding its way into the waste-box.

The first and second of these conditions secure the interests of the gas company, whilst the third greatly promotes the convenience of the consumer, for reasons that are well known.

Who that has had experience of Wet Meters does not know the disadvantages of the "Low Spout?" The slowness with which it adjusts the water line, and the patience required while this is being done, are matters of every-day experience. It is therefore no wonder that the "Syphon Overflow" is regarded as one of the most important improvements ever made in the Wet Gas-Meter. It is not only an important improvement **in itself,** but it possesses the property of making all previous improvements more valuable and effective. It has, indeed, made the Wet Meter a more perfect, and, in every way, a more satisfactory instrument.

Narrow views as to price often prevent the adoption of real improvements; but it would be a narrow view indeed which would prefer a "Low Spouted" Meter to one with a "Syphon Overflow," because of the trifling difference in the price of the two.

— W. & B. COWAN, —

— ESTABLISHED 1827. —

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2nd—Are suitable for all climates, whether hot or cold.
3rd—Incur no loss of Gas by Evaporation.
4th—Cannot become fixed by Frost, however severe.
5th—Are the most accurate and unvarying measurers of Gas.
6th—Prevent jumping or unexpected extinction of the Lights.
7th—May be fixed either above or below the level of the Lights.
8th—Cannot be tampered with without visibly damaging the outer case.
9th—Will last much longer than Wet Meters.
10th—Will not cost more than one-half for repair that Wet or Water Meters do.

Are upheld for five years without charge.

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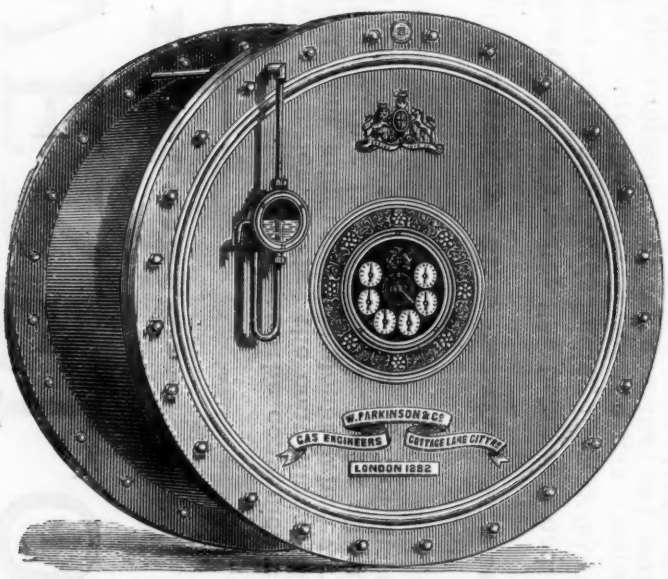

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BIRMINGHAM.
Telegraphic Address: "GAS-METERS."

10, MAWSON'S CHAMBERS, DEANSGATE.
MANCHESTER.
Telegraphic Address: "PRECISION."
[See also Advt. p. 989.

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THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, MAY 19, 1891.

The Meeting of the Institution of Gas Engineers.

THE inaugural meeting of the Incorporated Institution of Gas Engineers last week was a noteworthy success. To this result several influences contributed. In the first place, everybody concerned with the preparation or the execution of the programme was determined that this should be the case; and such a resolve carries its own fulfilment. Next must be cited the exceptional quality of the first President (Mr. G. C. Trewby), whose Inaugural Address and conduct in the chair were alike admirable. It is no disparagement of Mr. Trewby to say that his is not a character to catch the popular eye, nor is his usual demeanour calculated to impress the popular imagination. He is one of those quiet-mannered gentlemen who never show what may be in them, and never appear to trouble themselves about what other people think of them. When he accepted the not particularly enviable position of first President of the Institution of Gas Engineers—a society claiming to be able to show the world what British gas engineering is really like—there were those who supposed that this invitation was extended to him by his colleagues more as a recognition of his office at the head of the executive of the largest Gas Company in the world, than as a personal compliment. There were some drawbacks to the selection, which only need to be named to be recognized as serious. Mr. Trewby is no orator; and he never essays to "witch the world with noble" letter-writing. He had a sort of third-person reputation, being more often spoken of than speaking; and especially he had never exhibited any great interest in the professional or technical associations in which he occasionally appeared to the public gaze. And, to crown all, the Chief Engineer of such an undertaking as The Gaslight and Coke Company might be supposed to have his hands much too full to care to elaborate an address, or to be willing to give a couple of days to presiding over technical discussions, and to take so much trouble over the proceedings as might be desired of a first President of an organization born in dissensions and jealousies, and fighting for existence without any of the advantages of history, repute, or traditionary claim to respect.

The ordeal has been gone through; and the result is now so conspicuously good, that it seems absurd that it could ever have been doubtful. As to Mr. Trewby's presidency, it has once more vindicated the old saying that if work is to be well done it must be confided to a busy man. His presidential address is a most worthy production; being marvellously well and closely thought out for an author whose mind must have been so preoccupied. Moreover, it breathes of the engineer from the first line to the last—everything mentioned being discussed from the engineer's standpoint, not that of the capitalist, the accountant, or the *dilettante* critic. It is personal, pointed, and authoritative, and every sentence pays to the reader or hearer the compliment of being manifestly the author's best. There can be no higher praise for a composition of this order. And Mr. Trewby brought to the discharge of his ordinary presidential functions a quiet facility in the despatch of business that must have come of much labour in his proper occupation, which materially assisted to make the sessions patterns of the serious, conscientious study of gas engineering problems and of their possible solutions.

The Institution was favoured with good weather, which, although the outdoor excursions were restricted to the afternoon spent in inspecting the Kensal Green Gas-Works, had a vast influence upon the meeting. Nobody could be sour in such lovely May sunshine as flooded London during the greater part of the week. The absence of traditions and reminiscences was practically a great advantage to the Institution, since it was left free to make its own; and this, during the two days, it managed to do in a highly dignified and withal hard-working manner. All members occupied the same footing—nobody brought any prejudices, or tricks, or partisanship into the meeting, except the desire to help in giving the Institution a good start. Nobody spoke for the sake of speaking, or without saying something worth listening to. The President invited many speakers to contribute what they knew to the general store of information; and his invitations were invariably met with the utmost cordiality. In short, the tone of the meeting was thoroughly good and harmonious, and such as gave one pleasure to feel. There can be no more question of the fact that the Institution has started well, and bids fair to go on, doing good work and setting a great example to all similar societies the world over. It may never count so many members as The Gas Institute did; but this is neither necessary nor desirable. Among the numerous mistakes of past years in the administration of the then sole national organization of this kind was that of aiming at a large membership, with the object of securing a big surplus income for the endowment of technical education, research, &c. Without here reflecting upon the claims of such objects to patronage and support—and they have been abundantly

pleaded for in these columns—painful experience has shown that a generally comprehensive constituency, running into several hundreds of all sorts and conditions of men connected with the gas industry, is not a good thing to carry about the country. Consequently, one or the other consideration must prevail—either the itinerant character of a society of this kind must be sacrificed, or the numbers must be kept within manageable limits. So long as the Institution can pay its way, the question of numbers should not trouble the Council. All that need be thought about is the maintenance of the quality of the Transactions, and their publication in such a form as shall make the annual volume worth buying. The standard has been set, once for all, in the matters of presidential address, papers, and discussions; and it is for the Council to see to it that there is no falling off in other respects.

Patent Law Cases and Expert Witnesses.

The Wenham Lamp Company have gained their case as against the Champion Lamp Company, as will be seen by the report of Mr. Justice Vaughan Williams's judgment, which appears in full in another column. The particular lamp which was the *corpus vile* for this interesting legal experiment has been declared to be an infringement of Mr. Frank Clark's patent; and judgment therefore goes for the plaintiffs in the terms given. There are several points of the case which do not quite satisfy an impartial observer of the course of events; and it is so far consolatory that there may be an appeal. While we are thus precluded from discussing the merits of the action and the heads of the judgment, we are at liberty to draw attention to this particular example of the working of the expert witness system, which has been so frequently criticized in connection with the present fashion of administering the civil law. This seems to have also struck the learned Judge, who is sufficiently new to patent law business to notice matters of procedure that are familiar enough to regular Chancery Judges. He let it be seen that the expert testimony left him in the dark with regard to certain points. It must be obvious that in all such cases as the one in question, wherein the points in dispute are really matters of fact, the right place for the experts is that o assessors, not the witness-box. In Admiralty cases, it is not left for the side that has command of most money to bear down opposition by sheer weight of sworn testimony, as a coal barge is borne down by an Indiaman; but if it is the cause of the ketch *Polly* against an Atlantic liner, there are those present who are able as well as willing to see fair play all round. Yet in a neighbouring Court may be observed such a spectacle as that which perplexed Mr. Justice Williams, of all the strength, not merely of the Bar, but also of the witness-box, as a mere result of the command of money, being at the disposal of one side in the argument. Of course, if winning cases is to be regarded as always and essentially a matter of business, then this sort of thing is right and proper. If, on the contrary, as is generally supposed, those who appeal to the law of the land do so upon the ground of desiring that equal justice should be done as between man and man, then the actual system may amount to an informal, but very real, denial of justice to the side worse off in the matter of money than the other. As a rule, a person of scientific training and habit of mind never shows to less advantage than he does in the witness-box, when put there to exhibit his "crammed" acquaintance with a technical subject of which he is paid to exhibit only one side. It is a profitable line of business to those whose suppleness of intellect and power of grasping the leading points of a patent case bring them enough of it; but, even after making all reasonable, and even extreme allowance for those cases in which a diversity of technical opinion may be rightly exhibited by opposing interests, it remains fairly arguable that the true object of making men of science Fellows of the Royal Society, Doctors of Philosophy, and what not, is something very different from what is only too commonly seen in the Law Courts—helping the possessors of such distinctions to charge heavy fees for bolstering up, for wholly commercial purposes, claims preferred in the name of justice.

Some Considerations on the Eight-Hour Legal Day.

The so-called movement for making it a penal offence to work more than eight hours a day, does not move very fast; and it is probable that, but for a handful of noisy Trades Union Socialists, very little more would be heard about it. The men who have thus taken it up profess to think nothing of the fact that the most experienced leaders in workmen's politics see nothing hopeful in the idea but; it is instructive to contrast the New Unionist's childlike faith in the omnipotence of an Eight-Hour Act with his scornful treatment of the common law of the land when it happens to run counter to his wishes. The release of Wilson, the Cardiff rioter, from gaol, on the conclusion of his term of six weeks' imprisonment, has been one of the events of the past week. He was received at the gaol door as a martyr to principle, and feasted and "orated" over according to precedent in such cases. He has already, as we understand, started upon a "starring" tour of the Sunday mass meetings; his first appearance being announced for Sunday last, at a grand demonstration held in the Victoria Park under the auspices of the United Labour Council. This was a notable thing in the way of mass meetings, with six platforms and the usual appurtenances of "agitation." We have nothing to say against this fêting of Wilson by those who think that he suffered at Cardiff in a righteous cause; but it may be as well to point out that, as a matter of hard fact, Wilson was a law-breaker, and had to bear the consequences. Nor is there the remotest prospect of the law which he broke being altered in order to make violent assembly for the purpose of intimidating people objected to by mobs, a less hazardous proceeding for those who promote such behaviour. The common right of citizens to protection against rioters by the arm of the law, is likely to be more sternly guarded than ever as the political institutions of the country become more democratic. The one thing that any democratic form of Government must do uncompromisingly and ruthlessly, upon occasion, is to suppress anarchy, in the interest of the people themselves, who must not be deprived of their liberty because a few among them appear to be unable to distinguish between freedom and license. Yet Wilson is applauded for breaking this universal law, in the supposed interest of Trades Unionism; and the boast that it would be done again by him and others if necessary is a commonplace of the mass meeting. While agitators brag, however, they are very careful to confine their protest to empty words; for they do not in reality like imprisonment any more than do Irish "patriots." But does anybody doubt for a moment that, if the general sentiment of the community was as strongly engaged for the view that the common law against rioting and intimidation is iniquitous as it is for the contrary opinion, martyrs of the Wilson type would not be so numerous as first to bring the law into contempt, and ultimately to render it a dead letter? Suppose the case of a different law—the Eight Hours Act, in point—which would create an offence that nobody regards as such, and make it penal to do what has always been done with credit. Would it be possible to punish offenders against such a thoroughly artificial law? Assuredly not. Speaking in the course of the past week upon this subject, Mr. Burt, M.P., observed that it is one thing to have an Act of Parliament and another thing to get it carried out. Several Colonial Legislatures are believed to have passed Eight Hour Acts; but not one of them has proved operative. American State and British Colonial Legislatures are famous for experimental law making; and a very interesting magazine article might be written upon the laws that have failed to work, notwithstanding the good intentions of the framers and the acumen of the draftsmen who made themselves responsible for attempts to coerce human nature and deforce economic and social laws. Now that Mr. John Burns is out of work, through the failure of his strike business, he might do worse than look this subject up, in anticipation of the era when—much against his wish, he has declared—some admiring constituency is to force him into a seat in the House, free of expense, and with a handsome allowance.

A Curious Reversion.

It is a favourite pastime for professional humorists of a certain order to "poke fun" at the quaintnesses of olden times. Especially is this a trick of Yankee humorists and their imitators in the English newspaper press, who seem to surpass average Americans in maintaining the notion that whatever in human affairs is not American and "end of the century," must therefore be absurd and a fit subject for ridicule. Yet a thoughtful spectator of modern life is constantly being reminded of the thinness of the veneer called civilization which overlies, without

materially altering, the Aryan man. It is unnecessary, for the sake of this argument, to dilate upon New Orleans lynchings as proofs of the determination of the Aryan to to do justice somehow between man and man—if legally, well and good; but if formal law breaks down, then in the same way as his rugged barbarian forefathers did in the cradle-land of the race. Long after very substantial law and order were established in Europe, and before the noble red man of North America had seen the first white face on his coasts, our stupid old progenitors still did some very funny things in the way of sumptuary and mercantile regulations that should hugely amuse Mr. Mark Twain and publicists of his class. For example, they thought themselves competent to declare what the price of bread and other necessaries of life should be. It is true that they settled the rates of wages, horse hire, &c., also, in order that the income and expenditure of the common people might balance. But was this not an utterly silly attempt to make the laws of trade bend to presumptuous authority; and is it not a remarkable indication of the prevalence, in what are sometimes thoughtlessly called the "good old times," of ignorance and tyranny in high places? Yes; but what shall be said when we learn that at this present time the New York State Legislature have passed a law enacting that the price of gas sold in the city of Brooklyn shall be reduced from $1·50 to $1·25, and nobody seems surprised? We imagine the American Eagle would scream to some tune if the Brooklyn Gas Companies, whose number is alone a severe impeachment of the local administrators for old-fogeydom or worse, were to promote a Bill to compel all able-bodied men to work for them as required at a maximum wage of a dollar a day; but where is the difference? If a State Legislature can fix the price at which a commodity is to be sold, why should not the merchants be permitted to fix the prices and rates they are to pay for raw materials and labour? It is the old story. Scratch the Russian, and you find the Tartar. Prick the Yankee politician where he sits at his type-writer, surrounded with his telephone, phonograph, cuspidor, tariff-tables, and other refinements of his type of civilization, and you find at an inappreciable depth beneath the surface the same old puzzle-head who five hundred years ago sent round the Town Crier to announce the compulsory market price of wheat and ale.

The Labour Question at the Coventry Gas-Works.—It has been represented to us, by an authority fully conversant with the facts of this matter, that the report respecting the position of affairs at the Coventry Corporation Gas-Works which appeared in last week's JOURNAL, and which was obtained from a local source, hardly gave a fair statement of the situation. As we are now informed, there has been no innovation in the method of working the retorts, but the men have had the offer of a yearly agreement with a bonus, which they have accepted. The local agents of the Gas Workers' Union endeavoured to usurp the right of dictating to the Manager and the Committee as to how the carbonizing labour should be organized; and, in the result, the Branch Secretary of the Union has been discharged. The appearance of discontent in the Coventry works was a purely fictitious one, as the men's pay and the general conditions of their labour compare favourably with those of the district.

Southern District Association of Gas Engineers and Managers.—The members of this Association held their May or excursion meeting, on Thursday last. The programme, which had been excellently arranged by the President (Mr. John Methven, of Nine Elms) and the Honorary Secretary (Mr. J. W. Helps, of Croydon) comprised a trip by rail to Windsor and a drive through the Great Park from the Royal Borough to Virginia Water and back. The weather being delightful, the programme was carried out with great success. At Windsor, the party was welcomed by Mr. J. Wadeson, the Engineer and Manager of the Windsor Royal Gas Company, who conducted the visitors to the gas-works, situated adjacent to the Great Western Railway. These works are among the oldest in the kingdom, and, as usual in such cases, are much cramped for room, which is a consideration of less than usual importance in this instance, as the population of the borough is practically stationary. Mr. Wadeson is doing his best, with limited opportunities, so as to modernize his manufacturing plant; and with the assistance of his foreman, Mr. Simmonds, has designed a simple generator furnace, which works remarkably well. The waste heat from the retort-bench now in use is made available for raising all the steam required on the works. After lunch, which was hospitably provided by the President, the party visited as much of the Castle as was open to the public; and then went on the drive down the Long Walk and through the Park as arranged. The members and their friends dined together in the evening at the Star and Garter Hotel, Windsor. Mr. Wadeson, Mr. Strange, the Secretary of the Gas Company, and Mr. Wadeson, jun., kindly acted as guides to the interesting places visited.

WATER AND SANITARY AFFAIRS.

ONE of the most remarkable events in the recent history of the Metropolitan Water Supply—so remarkable as almost to possess the character of a portent—has just presented itself, in the shape of an agreement between the Corporation of the City and the London County Council. Technically and formally, the terms may not yet be fully ratified by the Corporation; but the negotiations have gone so far, and have been pronounced so "very satis-"factory" by the Chairman of the County Purposes Committee, that we are warranted in speaking of the compact as virtually settled. Some element of disturbance must be introduced, or some change of mind come to pass, if the results so far arrived at are to be nullified. Possessed apparently with a full conviction that the London Water Supply is to pass into the hands of the County Council, the Corporation—as represented by one of its Committees—has consented to forego its own dignity, founded on the tradition of centuries, and to take a subordinate part under an institution not yet three years old. The project—which Parliament may or may not sanction—is that there shall be a Statutory Committee of the County Council, to take the control of the water supply, and one-eighth of the members of this Committee shall be nominated by the Corporation. The details of administration are to be left to the Committee thus to be constituted; but "all questions of policy, terms of ac-"quisition of the Water Companies' undertakings, charges "to consumers, and finance," are to be subject to the control of the Council. This will not be a Joint Committee acting on behalf of the two authorities. As a Committee, it will be responsible to the Council; and, however much the Corporation may dissent from the decisions of that body in reference to the water question, the Committee must obey the Council. Not even the seven-eighths appointed by the ruling power can offer resistance, much less the one-eighth nominated by the Corporation. The County Council may be right in assuming this authority. When two men ride upon one horse, one of the two must be first. But the Corporation has no need to ride the horse at all, or to share any mishap which may be encountered on the way. It is by no means certain that the County Council, if it gets possession of the water supply, will manage the affair wisely, or in such a manner as will gain popularity. Yet according to the plan that is now proposed, the Corporation will be entangled in any policy the County Council may adopt on this subject. An independent attitude will be impracticable, and the "ancient and honourable" will be merged in a one-eighth minority serving on a Committee at Spring Gardens. The Corporation may think it better to have a finger in the pie than to be left out altogether; but we should hardly have thought the City Fathers would have stooped to such very humble pie as this. What good they are going to get by any such extraordinary arrangement we cannot at all conceive. But it is abundantly plain that the County Council is in a fair way to gain something. The Special Committee on Water Supply, of which Mr. James Beal is Chairman, say in a report referring to the terms of the Metropolis Water Supply Bill: "The City Corporation are at one with the "Council in objecting to a compulsory requirement to pur-"chase the Companies' undertakings on arbitration terms, "and it has been suggested that the Council and the Cor-"poration should unite in opposing the Bill before the "Select Committee." After this, the Special Committee proceed to state: "We have come to the conclusion that "it will be greatly to the public advantage if the Corpora-"tion and the Council join hands in the attempt to give "London the control of its water supply." This is well put. It is not London, but the London County Council which is to have the control; and the Corporation is to help the County Council in upsetting the Metropolis Water Supply Bill, in the promotion of which the Vestries and District Boards have spent their hundreds of pounds.

Last week the Select Committee under Sir Matthew White Ridley deferred the further consideration of the Metropolis Water Supply Bill, and proceeded with the Bill of the Southwark and Vauxhall Water Company. The Local Government Board had in the meantime done its best to prejudice the prospects of the Bill, by issuing a "special report," setting forth certain objections, and proposing sundry onerous conditions. Mr. Bidder, Q.C., in opening the case for the Company, very naturally com-

plained that certain unknown gentlemen "sitting in back "chambers of the Local Government Board," and having only an imperfect knowledge of the subject, should scatter imputations broadcast, and be able to keep out of reach. On the following day, Mr. Balfour Browne, Q.C., as representing the Thames Conservators, complained of some imputations cast on the purity of the river by Mr. Freeman, who represented the London County Council. The Chairman signified that the quality of the water would not be taken into consideration on a purely Money Bill, but would be "gone into thoroughly" on the other Bills which would come before the Committee. In support of the allegations contained in the document issued by the Local Government Board, some evidence was offered by General Scott. On the whole, it may be said that even the adverse evidence helped the Bill. It can never be urged, in the face of the statements made by the Local Government Board, that further structural works and additional engine power are not necessary to enable the Company to maintain a proper supply. Yet we find Mr. Freeman suggesting, on behalf of the London County Council, that some officer from the Local Government Board should supervise all future works, and decide as to their necessity and cost. Such intervention as this would constitute a dual control, which would impair all responsibility, and would probably lead to some very awkward results. The plan adopted by the Committee, was that of inserting a clause allocating the capital to certain specified works; the total amount to be raised being £300,000. In the course of some discussion concerning the City Chamberlain's sinking fund, it was remarked that, by purchasing stock and then cancelling it, a present was made to the Water Company concerned. If so, the process resembles that by which an Irish enemy of the Beresford family is reported to have burned all the notes of the Beresford Bank that came into his possession, under the idea that the Bank lost money by the transaction. However, there is to be "an ultimate extinguishment" in respect to such share capital as the City Chamberlain may purchase in the Southwark Company. Mr. Freeman proposed that the County Council should lend money to the Company; but the Committee wouldnot hear of it.

Mr. Wigham's New Lighthouse Burner.—In the House of Commons on Monday last week, Dr. Cameron again referred to Mr. J. R. Wigham's new lighthouse burner, with regard to which he had on a previous occasion put a question to the President of the Board of Trade. He pointed out that the improvements effected by Mr. Wigham had been made since the report of the Committee of the Royal Society on the South Foreland lighthouse experiments had been issued; and he asked whether or not the Board of Trade would direct the attention of lighthouse authorities to the subject, with the view of their investigating it. Replying to the question, in the absence of Sir M. Hicks-Beach, Baron De Worms said the President was not prepared to suggest that any further expense should be incurred in connection with the inventions of Mr. Wigham or anyone else, as it was the duty of the Board of Trade to control rather than to initiate expenditure.

Conscience Money from a Water Consumer.—In an advertisement which appeared on the front page of *The Times* last Friday, the Secretary of the West Middlesex Water Company acknowledged the receipt of two five pound notes, "sent anonymously, for payment for water used without notice." Although announcements of the receipt, by the Chancellor of the Exchequer, of sums of money of various amounts from persons whose consciences accuse them of having attempted to defraud Her Majesty out of certain revenues in the shape of income-tax, are not unfrequently to be seen in the papers, it is rare indeed for a Water Company's Secretary to have to make an acknowledgement such as the one above noticed, notwithstanding that these officials are equally, in some people's estimation, fair objects for the exercise of the circumventing capacity of parties who are legally liable to them for the payment of money. There are, however, ill-natured people who say that the qualms of conscience suffered by income-tax payers are engendered by the tardy receipt from the Commissioners of Inland Revenue of an intimation that their "little game" has been found out, and that the adoption of the "anonymous" mode of discharging their indebtedness will save them the unpleasant exposure which legal proceedings would entail. In the case of this water consumer, the thought that his act is one of repentance for wrong done is really touching; and therefore it is a pity that we have to confess that it is just tinged with the suspicion that he was caught, *flagrante delicto*, "conveying" someone else's property—or, to put it more euphemistically, using water without notice—and was advised to publicly acknowledge his error or submit to the consequences.

THE INCORPORATED INSTITUTION OF GAS ENGINEERS.

PROCEEDINGS AT THE GENERAL MEETING,

HELD AT THE

INSTITUTION OF CIVIL ENGINEERS, MAY 12 & 13, 1891.

Mr. G. C. TREWBY, M. Inst. C.E., President.

REVIEW OF PROCEEDINGS.

UNDER the most favourable climatic conditions, the first business meeting of the Incorporated Institution of Gas Engineers was opened, under the presidency of Mr. G. C. Trewby, M. Inst. C.E., Chief Engineer of The Gaslight and Coke Company, at a few minutes after half-past ten on the morning of Tuesday, the 12th inst., in the Lecture Theatre of the Institution of Civil Engineers, Great George Street, Westminster. It is desirable to put these particulars on record, because the occasion deserves to rank among historical events in the chronicle of British gas engineering development. It was impossible for an observer acquainted with the circumstances that have led up to the formation of the new Institution, and familiar with the personality of the profession of gas engineering in this country, to witness without reflection the spectacle of this well-known assembly-room, as on this particular occasion it appeared, once more given up to a meeting of gas engineers and managers. The last time such a gathering took place in this hall was in June, 1889, when the disruption of The Gas Institute had just been consummated, and the meeting was held under the chairmanship of Mr. George Garnett, M. Inst. C.E. Last Tuesday's assembly was like and unlike its precursors, dating back to the days before the great division of 1888-9. Many of the familiar faces of old times supported Mr. Trewby on the dais, or faced him from the benches—which, by the way, are now all on the same level, instead of being raised in tiers from the front, as formerly. But there were present in the meeting many fresh faces, whose owners, by their attendance and subsequent participation in the transactions, demonstrated that the new Association then in course of inauguration is something more than a split-off from the old Institute. And the difference between the new Society and the old one was even more strikingly displayed in the absence of much that was once as conspicuous as it was unpleasant. To begin with, the meeting took place *inside* the premises of the Institution, and not on the pavement of Great George Street. It was also possible to mount the stairs and gain the theatre without running the gauntlet of animated advertisements of the various commodities required for the supply of gas-works; and whereas in the old times, even before the later dissensions had separated the members of The Gas Institute into antagonistic camps, they were always divisible into the party that came to work and the party that cared only to play, this meeting was unmistakeably bent upon business. The air of serious attention to the work in hand which pervaded the gathering from the commencement, was preserved to the end of the two days' proceedings.

This, however, is to anticipate. Returning to the beginning of Tuesday's doings, it was evident from the start that Mr. Trewby did not mean to lose time in unnecessary formalities. In a very few minutes, yet without the slightest semblance of hurry, the report of the Council was presented and adopted, the three Trustees appointed, the Secretary (Mr. Thos. Cole, Assoc. M. Inst. C.E.) introduced and installed, and the President was "up" for reading his address. It is a convenient juncture here for expressing once for all the recognition that Mr. Trewby's whole conduct in the chair deserves. He was simply a perfect President of a technical gathering of this class—businesslike, expeditious, urbane, and firm to keep the meeting in hand. To him in a very great measure the technical success and smoothness of the gathering must be ascribed. The habit of despatch and the conciliatory temper which any person in such a position as that occupied by Mr. Trewby must needs possess, served the young

Institution well on this occasion. Had the meeting been as charged with conflicting elements as it was in point of fact harmonious, the presidential task would, of course, have been more difficult. But although the meeting did not require much ruling, it wanted leading; and to this important duty the President was always equal.

Mr. Trewby then delivered his Inaugural Address, which appeared in full in last week's JOURNAL. It was Inaugural on two accounts, since it not only introduced the President in his official capacity as head of the Institution of Gas Engineers, but also inaugurated the organization itself as a new influence in the development of the art and industry of gas supply. Mr. Trewby's message to his professional brethren is now before the world; and the gas engineers of the United Kingdom have already made up their minds as to its quality. Before many days the members of the profession all over the continents of Europe and of North America will have had the same opportunity of judging whether the first presidential address promulgated under the auspices of the newest technical organization is to be held worthy of the occasion. We have not the slightest hesitation in asserting that if the general verdict upon Mr. Trewby's performances could be collected, it would be the same as that which made itself heard in the hall in the applause that rewarded the speaker when he had brought his observations to a close. Alike in manner and matter, it is a thoroughly good, sound, solid discourse upon just such topics as the Chief Engineer of the largest Gas Company in the world might be expected to have continually under his consideration, and upon which his candid opinion would naturally be desired by his colleagues in the profession. Mr. Trewby would not thank us for praising his address for what it is not; and we do not ascribe to it any striking picturesqueness of arrangement, or what is usually called eloquence of diction. What we do say, however, is that the address fulfils in a most satisfactory manner the scheme of an acceptable composition of this nature, as frequently stated in the JOURNAL, inasmuch as it eschews retrospect and review of past and current events and practice, and is wholly composed of expressions of the speaker's personal opinions, supported as required by original data. No presidential address so planned can fail to be interesting; and it will be valuable according to the quality of the opinions which it expresses and the evidence upon which they are based. In this case, when the plan was once settled in the speaker's mind, the rest followed as a matter of course. For who should be able to tell gas engineers what it is useful for them to know, if not the Chief Engineer of The Gaslight and Coke Company, which is more than an undertaking, and may be called an industry of itself? And the event has proved, that if much was expected of Mr. Trewby, in his position as the cynosure of a host of by no means wholly admiring eyes, the performance more than satisfies criticism; and the first Inaugural Address from the chair goes far to justify the existence of the Institution.

The first topic dealt with after the speaker's personal acknowledgments was the evidence already afforded of the representative character of the Institution, which has an actual membership responsible individually for the management of gas undertakings worth upwards of 23 millions of money. Starting with this fact as illustrative of the position and prospects of the Institution, the President quickly passed on to consider the present condition of the statutory gas industry of the United Kingdom, and brought forward highly satisfactory figures illustrative of the growth of the business within the past seven years for the whole of the United Kingdom, and the past ten years for London. This was the only part of the address which utilized what may be called public data; and seeing that the stability and expansion of the gas industry are of public concern, it is just as well that there should be no secret about the evidence upon which the existence of these conditions is asserted at the present time. It soon became evident, however, that Mr. Trewby meant to treat his statistics as an engineer, rather than as an adviser of investors and a cautioner of speculators. The financiers may make what they please of the totals in question; but the Chief Engineer of The Gaslight and Coke Company drew from his data, when supplemented by valuable special information, some interesting and highly important deductions concerning the day consumption of gas. In view of what the Corporation of Manchester are doing in the direction of sanctioning an inquiry into the advisability of instituting differential rates for cooking and power gas, it must be considered that Mr. Trewby's powerful argument against favouring one class of gas consumption at the expense of another is distinctly appropriate to the times. It has always been a noteworthy fact, that whereas differential prices for day and night supplies of gas have been approved of in various places, nothing of the kind has found favour in London; and Mr. Trewby now shows us why. Attaching, as he does, the highest value to an increased day business, he brings into the clearest prominence the fact that even if a day demand for power only is considered in the light of the experience of the London Hydraulic Power Company, the requirement does not cease with dusk. And if it is further remembered that, especially in well-to-do residential neighbourhoods, a great many households that cook by gas dine late, it is impossible to resist the conclusion that, under ordinary circumstances, the demands for heat and power gas will be found to seriously overlap the diurnal period of heaviest demand for light; or, as the address has it, that "the maximum output on a winter's day is the aggregate of the greatest demands for each—viz., light, heat, and power." This argument disposes of the plea for cheapened gas for cooking and heating, except it may be from primitive localities where the people only cook in the middle of the day and in summer time go to bed at dusk.

The only reference to electric lighting in the address is couched in terms which, for a presidential oration to a gas engineer's meeting, are refreshingly original. Instead of the usual vague generalities about "gas having nothing to fear from the electric light," the President's references to the storing of current, and the cost of generating and supplying electro-motive force as compared with the cost of gas-engine power are very much to the point; and the reserve which marks Mr. Trewby's comments upon this head renders what he does say all the more impressive.

Here the address breaks off from considerations of the position and prospects of the gas industry, and plunges into matters of gas engineering practice. It is natural, in view of what the President's professional responsibilities have led him to adopt at different stations of the Chartered Company, that he should draw his hearers' attention to the advisability of developing the mechanical handling and conveying of coal and coke and other gas-works' materials in a more thorough manner than has hitherto been done even in the largest works. It is obvious that modern gas making in this country has gone very far beyond the weight-shifting capacity of "the man with the wheelbarrow;" and it is high time to think of all convenient means for eliminating or reducing handwork in gas-manufacturing stations. If this need had not been brought out by the growth of gas-works, it would have been made apparent by another kind of growth—that of the unreliability of the unskilled labourer, with whom Mr. Trewby evidently has a good deal of trouble. We do not flatter ourselves that any words of ours upon such a delicate subject will have the slightest weight; but, still, we make bold to inquire whether the wire-pullers of the Gas Workers' Union think that the way their supporters show in the working of The Gaslight and Coke Company, as hinted at by Mr. Trewby in his address, is any recommendation of Union hands as compared with free labourers? Messrs. Thorne and Ward are never tired of running down the free labourer as compared with the Union hand; but it is as clear as daylight that the free labourers in the London gas-works from which the Union has been ejected are far and away better men than the average Union man, as the Chartered and Commercial Company find him.

Passing, however, from this subject, which is a sore one, we shall find in the address a handsome testimonial to the value of inclined retorts. Of course, Mr. Trewby prefers them with his own modification, for which there is undoubtedly much to be said. We have always been of opinion that M. Coze's system would have to be considerably modified before it would gain general favour among English gas engineers; but, modified or not, there seems now to be a good bulk of opinion in its favour. A great deal has depended upon the extensive trials of inclined retort working which have been started under Mr. Trewby's supervision in several of the largest works of his Company. Like all new things, the regular operation of these retorts upon a large scale has been attended with a good deal of initial trouble. But perseverance has conquered; and the statement of the success of the inclined retorts at

the Kensal Green station, which the President was able to make, will be welcomed by many.

After a graceful reference to Mr. Livesey's appointment on the Labour Commission, Mr. Trewby became once more intensely practical upon the subject of carburetted water gas, respecting which he had a good deal to say that was worth hearing. It sounds like "good business" for the United Gas Improvement Company of America, and strikes a new day for London gas making, when Mr. Trewby announces that, after experience of water-gas plant capable of making 2 million cubic feet of gas per day, The Gaslight and Coke Company are about to extend this plant threefold, upon his recommendation. It is Mr. Trewby's opinion, however, that with fluid hydrocarbons suitable for use in making water gas at their present prices in the English market, this gas must be useful to the British gas manager mainly as an enricher. It does not pay to make 16-candle water gas; but in certain circumstances it will pay to make 25-candle water gas, and to keep plant as a stand-by for meeting sudden demands for gas in early winter. All that Mr. Trewby has to say upon this topic is marked with great good sense. He is not afraid to contemplate a possible era when London gas, being raised to some considerably higher standard of brilliancy than it has at present, may be made to go very much farther than it now does for all purposes. This is, of course, the lesson of American experience, which we have abundantly expounded in the JOURNAL. It is that if it pays to make water gas at all, it will pay to make it pretty good, which has the effect, among others, of knocking the incandescent electric light out of the running for popular favour. At the present time, General Webber complains that the people of Chelsea want much more powerful incandescent electric lamps than it suits their purpose to pay for. If in a club or a private house nothing but 8-candle lamps are seen, General Webber entertains the amiable delusion that the inmates are content therewith, and do not notice the difference between the small-power lamps and an ordinary gas-burner. Directly electric lamps are put into a shop window, however, they look very dull beside the flaring gas flames which inconsiderate and unscientific corner publicans, butchers, &c., persistently prefer. Consequently, the æsthetic shopkeeper who patronizes the electric light company, has to adopt what are called 32 and 64 candle lamps, which run into a shocking sum per quarter, or, as an alternative, return to gas. Mr. Trewby evidently holds that the power to increase common coal gas to the ordinary American water-gas standard of illuminating power, may prove a trump card in the game of competition for the future lighting of London.

With a brief but unanswerable exposure of the delusion that anything else but coal gas, or coal and water gas, can supply acceptable gaseous fuel for London competent to disestablish the smoke evil, this most practical and yet suggestive of Presidential addresses was brought to a close. When the speaker sat down, it was the palpable feeling of his auditory that, whatever else might transpire at this first meeting of the Institution of Gas Engineers, the Inaugural Address would unquestionably make its mark in universal gas engineering literature.

Mr. George Livesey was quickly on his feet, after the cheering had died away, to offer a spontaneous and graceful compliment to the President upon his address, which perfectly suited the temper of the meeting. Then without any break, to a full audience, Mr. A. M'Minn read his paper on inclined retort working and labour-saving methods of coal handling, which proved to be a highly instructive and important communication. The paper was amply illustrated by diagrams, and was supplemented by an oral exposition by Mr. Ruscoe of the rope-driven machinery put up by him at Beckton to work Mr. Trewby's modification of the inclined retort idea. This filled up the time till the hour of adjournment to the Kensal Green Gas-Works, where the members were entertained to luncheon by the Directors of The Gaslight and Coke Company, whose hospitality was fittingly acknowledged.

It soon appeared that this inspection of the Kensal Green station was the great attraction of the meeting. All the visitors were professionally and individually concerned in the practical problems that Mr. Trewby and Mr. M'Minn have essayed to solve at this most interesting establishment; and both these gentlemen were plied hard and fast with crucial questions, which they answered with unwearied courtesy and in the fullest and frankest manner. There is much to be seen at Kensal Green; and the entire afternoon was barely sufficient for a glance at the different extension works in operation or in progress. The workmanlike three-storey purifier-shed came in for a good share of admiration; but naturally the retort-house and the coal hoisting and conveying plant were the centre of interest. Summing up the impressions conveyed by Mr. M'Minn's paper, the inspection of the works, and the discussion on the following morning, the position seems to be something as follows: Such of the members of the Institution as are in the habit of receiving coal supplies by rail were compelled to put themselves, by imagination, at a different standpoint, in order to appreciate the "grab" method of discharging coal from barges. Those who are used to working barges approved of the method; and those who take their coal direct from ships wished they could avail themselves of it. With regard to the conveyor and elevator system as applied at Kensal Green, opinions are very conflicting. That the system is well worked out is universally conceded; and the necessity for something of the kind, particularly for inclined retort working, is also admitted. The desirability of trying at least one large retort-house upon any system of coal handling that has any *primâ facie* claims to respect, is not denied; and great credit is given to Mr. Trewby, and those who have worked out the application in point under him, for the thoroughness with which the experiment has been gone into. Interesting results must follow therefrom; but it is not too much to say that they will be waited for before anything more is done in the same fashion. The whole conveyor and elevator arrangements at Kensal Green seemed to be regarded by the mass of Mr. Trewby's visitors as strange, and not altogether "canny," additions to the carbonizing apparatus of gas-works. To say that these engineers were hostile to the scheme of this machinery would be to ascribe to them an unscientific spirit which they would rightly repudiate. Men neither like nor dslike a thing of this sort. It is with a gas engineer a case of "Handsome is, as handsome does;" and if the Kensal Green plant justifies itself in the course of working over a sufficient period, it will certainly be taken into favour. The initial expense of such plant is a serious consideration which will require to be outweighed by some very potent and patent working advantages, if it is ever to become popular even for the largest works.

The dinner of the Institution on Tuesday evening was a great success. There was good company, good cheer, good speaking, and good music. So circumstanced, a successful inaugural banquet was a natural result. Most of those members of the Institution who attended the meeting put in an appearance, albeit that there are many counter attractions to a public dinner for visitors to London at this season. Among those who came to wish godspeed to the new Institution by this characteristically national fashion of the Dinner were Mr. W. Woodall, M.P., and Mr. A. Vernon Harcourt. The President of the Société Technique de l'Industrie du Gaz en France (M. Salanson) sent his apologies for absence. But Mr. J. Hepworth, M. Inst. C.E., President of The Gas Institute, was present, to the general pleasure, for he is personally liked wherever he goes; and the men who have founded the Institution, having taken their own way, are nowise inclined to keep up a feeling of animosity against the whilom colleagues from whom they have publicly separated.

Wednesday's business began betimes with the though discussion of Mr. M'Minn's paper of the previous day, followed up by the reading of the three papers on water gas and the allied subjects, which will be found in another column, contributed by Mr. T. Goulden, Mr. A. G. Glasgow (of America), and Mr. William Foulis. These papers gave the opportunity, which was freely taken, for a good threshing out of what is indubitably one of the most pressing questions of contemporary gas management. The partisans of water gas ought to congratulate themselves upon the full presentment which their general case received on this occasion, and the scientific spirit which was manifested within the Institution with regard to it. On the other hand, Mr. Foulis established that oil for carburetting may be as useful to the British gas maker without water gas as with it. This is a result that should comfort the oil interest, and solace the gas manager who sees his old stand-by—cannel—soaring out of his reach. It is to be regretted that carburetting with oil gas made in the usual retorts

is apt to be more troublesome than effective; but there is help in gasoline. In this case the discussion (to be given next week) was quite as good as the papers.

We shall also give Mr. Hunt's paper on "Purification," and Mr. A. Colson's paper on "The Leicester Gas-Works Extension," with the discussions thereon, in our next. For the present, it must suffice to state respecting them that they were well worth their place in the programme; and that Mr. Colson's paper was abundantly illustrated by such a profusion of beautifully-executed drawings as should make it, when reproduced entire, with these appendices, in the Transactions of the Institution, a sufficient inducement to any gas engineer, whether student or practitioner, to buy the volume. It is, in our judgment, one of the best, if not the very best paper on gas engineering construction ever brought before a technical society of this or any country.

With a few complimentary votes, the first meeting of the Incorporated Institution of Gas Engineers was, late on Wednesday afternoon, brought to a close, after two days of such thoroughly good work as must be considered to have established its position among the professional and technical organizations of the world. A highly satisfactory start has been made; and this is proverbially "half the battle." There should be little difficulty in keeping up in Liverpool, in the autumn, the character of performance set last week; and if this is done, British gas engineering will be seen far and wide to have secured such representatives as it has never enjoyed hitherto.

REPORT OF PROCEEDINGS.

The Special General Meeting of this Institution was held last Tuesday and Wednesday, at the Institution of Civil Engineers, Great George Street, Westminster—Mr. G. C. Trewby, M. Inst. C.E., the President, in the chair.

The minutes of the first annual meeting, held on the 12th of February, and the report of the Council (which had been printed and circulated), were taken as read. The main portion of the latter was as follows:—

Report of the Council.

At the annual general meeting held in February last, the position of the Institution was fully reported upon. There were, however, some matters of importance which could not be dealt with until the present meeting.

Under the provisions of the Articles of Association, three Trustees have to be appointed; and the Council is pleased to state that Messrs. George C. Trewby, William King, and William Foulis have kindly consented to accept office, if elected.

Subject to the approval of the members present at the meeting, the Council have secured the services of Mr. Thomas Cole, Assoc. M. Inst. C.E., Secretary to the Incorporated Association of Municipal and County Engineers. In recommending this gentleman to the members for appointment as Secretary, it desires to express its belief that he will in every way prove an efficient officer.

It is proposed to hold an autumn session in Liverpool, on Tuesday and Wednesday, Oct. 13 and 14. In anticipation thereof, a circular calling attention to subjects of interest will shortly be issued; and the Council trusts that instructive papers may be forthcoming for that meeting.

Accompanying the report was the balance-sheet and the list of members.

Appointment of Trustees.

Mr. F. T. C. Linton (Leith) moved that Messrs. C. Trewby, Wm. King, and Wm. Foulis be appointed Trustees of the Institution.

Mr. R. Morton (London) seconded the motion, which was at once carried unanimously.

Appointment of Secretary.

The President then moved—"That Mr. Thos. Cole, Assoc. M. Inst. C.E., be and is hereby appointed Secretary of the Institution, at a salary of £60 per annum, to increase by £10 per annum up to £100 per annum." He said there was a paragraph in the report of the Council stating that this appointment had been made subject to the approval of the members, and that it was believed that Mr. Cole would prove in every way an efficient officer. He need hardly say that the Council had made every inquiry, and were persuaded that Mr. Cole would render valuable service to the Institution.

Mr. T. May (Richmond) seconded the motion, which was at once carried unanimously.

Mr. Cole said he was extremely obliged for the honour conferred upon him; and he would do his utmost for the success of the Institution.

The Meeting in Liverpool.

The President said it would have been seen by the report that it was proposed to hold an autumn session in Liverpool, in anticipation of which a circular would shortly be issued calling attention to special subjects of interest, and inviting papers. Under the Memorandum of Association, there was power to hold any number of meetings which it was deemed desirable. The Council had very fully considered the matter, and thought that, in the interest of the Institution, it would be advisable to hold an autumn meeting; and he therefore proposed that the next meeting be held in Liverpool, on Tuesday and Wednesday, the 13th and 14th of October next.

Mr. W. King (Liverpool) said he had much pleasure in seconding the motion; and he might add that, if the Institution honoured Liverpool with a visit, he should be very glad to co-operate with the officers in making it a pleasant one.

The motion was carried unanimously.

Inaugural Address.

The President then delivered his Inaugural Address, which was given in the last number of the Journal.

Mr. G. Livesey said he did not think the address ought to be allowed to pass without the members at once returning a vote of thanks to the President for it. He was sure that very few members envied this gentleman his task. There had been so many addresses on gas questions during late years, that all the "plums" might be said to have been already picked out; and few, if any, would regret that the lot had not fallen on them to discharge this duty. Mr. Trewby, however, had dealt in an admirable manner with many subjects of surpassing interest. In the first place, he showed the vitality of their business; he then went on to deal with various schemes and ideas of pressing importance for the development of the industry; and the improvement of the manufacture and the cheapening of the product had been dealt with in a manner which must have excited general admiration. He felt that the Institution had made a very auspicious beginning; and he had much pleasure in moving a hearty vote of thanks to the President.

Mr. A. Kitt seconded the motion, which was put by Mr. Livesey, and carried unanimously.

The President, in reply, said he commenced writing the address with some degree of trepidation, which increased as he went on; and had it not been for the kind assistance rendered him by some of his friends, he feared he should have been quite unable to produce anything worth listening to. Being occupied with the conduct of a large undertaking, every moment of his time was very fully engaged; and he had not so much leisure as some others must have had to devote to this purpose. However, the consolation he derived in finding that his address had been approved and appreciated, fully rewarded him for the trouble he had taken.

Mr. A. C. M'Minn Kensal Green) then read the following paper:—

THE INSTALLATION OF INCLINED RETORTS AND OF LABOUR-SAVING APPLIANCES IN CONNECTION THEREWITH.

An apology is unnecessary for the introduction of the above subject, since it is now largely occupying the attention of gas engineers. Owing to the short time that the installation at Kensal Green has been working, the author had some hesitation in bringing it before the members of this Institution; but feeling that any information on the subject would be welcome, he has much pleasure in responding to the invitation to contribute a paper thereon. He feels that the greatest interest will necessarily centre in the discussion, in which it is hoped that the experience of other engineers will be available. Dealing first with the question of inclined retorts, it was the original intention of the author to confine himself to the Coze system; but as there are several other important systems now in operation in this country, he proposes to include also a notice of these.

The retort-house at the Kensal Green works had already

been constructed when it was decided to erect the inclined retorts; its dimensions being 389 feet in length by 70 feet in width, with a range of coal-stores, 21 feet in width, on either side. With this width of house, it was found practicable to erect two lines of arches, arranged for 34 beds of seven retorts in each, set back to back, or a total of 476 mouthpieces. The arches were constructed slightly elliptical in form, so as to give as much room over the side-middle retorts as practicable. The inclination of the arch was stopped 14 inches from the front, and continued horizontally to the face; thus affording a good bearing for the cross girder between the buckstaves, and at the same time forming an abutment to the sloping arch. It is obvious that the setting of retorts at an angle of 29½ degrees is attended with difficulties absent under the old system, and is therefore more costly; not the least trouble being connected with the attachment of the cast-iron charging-shoots.

The Coze retorts are 12 feet 6 inches long, and weigh about 19 cwt. each. Their section proper is 24¾ inches by 13¾ inches, reduced to 22¾ inches by 11¾ inches at the ends. As may be supposed, the manufacture of retorts of this length involves many difficulties; resulting in twisted and irregular shapes, which are awkward to deal with in setting them. Such irregularities would be bad enough to deal with in the ordinary setting; but when it is remembered that connections have to be made with the castings forming the charging-shoots, it will be realized that these difficulties were much increased. The retorts are supported by four cross walls dividing the setting into five spaces, each of which is heated from two nostrils formed in the furnace arch. The size of these nostrils was originally furnished as being the result of working an experimental setting—viz., all 2½ inches wide, and varying from 2¾ inches long at the front to 2 inches at the back; but, for reasons subsequently mentioned, it was found necessary to alter them as follows: The two nearest the front were made 4 inches square; the third, 3½ inches; the fourth, 2½ inches; while the back one was left at its original size. This arrangement was found to give uniform heating of the setting, and was a point of importance, since it was but natural to suppose that the tendency of the heat to ascend would cause the upper portion of the retorts to become hotter than the lower.

The form of furnace required careful consideration, in order that the heats might be thoroughly under control; and for this purpose a separate generator was provided to each bed—thus making its working independent of any other. The author has always felt strongly against the use of complicated regenerators (very excellent results having been obtained by simple gaseous firing); and in the ordinary setting at Kensal Green, the main flues being on the top of the beds, no attempt at "regeneration" has been made. In the case of the inclined retorts, however, it was found convenient to place the main flue at a low level at the back of the bench; and as the waste gases had to be led down to it, advantage was taken to make the flue conveying these gases in such a manner as to form a very simple regenerator.

The front of the beds are tied by means of steel buckstaves of the bulb form, weighing 44½ lbs. per foot, concreted into ground at the bottom, and tied at the top by 2-inch rods provided with an adjusting screw. To guard against any downward movement of the arch, a steel H-girder, 5 in. by 5 in. by ⅝ in., was fixed against its face, secured at the ends to the buckstaves. The lower mouthpiece, in addition to the ordinary bolts, was held in position by T-bars, 5 in. by 5 in. by ¾ in. These mouthpieces are brought from the oblong shape of the retort to a circle of 21¼ inches. Their weight is considerable, each being nearly 3¼ cwt.; and since it was neither advisable to contract the area of the mouthpiece, and so retard the delivery of the coke, nor to shorten it, as this would have brought the ascension-pipe nearer to the front wall than is the author's usual practice, a light patent steel lid was adopted. One of these lids, with cross-bar complete, weighs only 76 lbs.

The tramway on the top of the beds, carrying the travelling scoop-carriage for conveying the coal to the retort, is formed of 40-lb. rails bolted to longitudinal wrought-iron plates resting on the brickwork, and kept to the proper gauge by distance plates. This arrangement allows the line to be adjusted by packing, should it get out of level.

With regard to the working of the Coze retorts, these were required to be ready for the winter of 1890-91; but they could only be used in connection with the entirely new plant that was in course of construction. As fast as the settings were finished, they were carefully dried, and kept at such a temperature that they could be quickly brought into action when required, in which state they were maintained for several weeks. During this period, and before any retorts had been charged, it was observed that the bends of the coal shoots were at a red heat; but it was understood that they were to be worked in that condition. They had been built in accordance with the drawings and directions given; a wall being carried up at the back of the castings, and a similar wall a few inches distant against the back of the bed—the space around the castings being filled in with loose place brickwork. As soon as a section of the purifiers was finished (the other apparatus having been already completed), the retorts that had been got ready were charged, and all went off well. It may be remarked that there was a considerable amount of leakage from the joint between the retort and the shoot casting. This, however, quickly took up, and generally disappeared after the second charge. For the first few days, owing to the coal-distributing plant (to be afterwards described) not being ready, the coal had to be hauled up to the hoppers by manual labour; and during this time the charges were got into the retorts in a very satisfactory manner—the coal being very evenly spread, and well burnt off. After the first few days, a portion of the elevating and conveying plant was brought into use.

The new works were started at the beginning of January, and during the severe and long-continued frost. No fresh coal was being received, owing to the canal being frozen over; and all that was available for the retorts in question was that which had been stored for many months in the open. It was brought from the heap, by the locomotive crane, cemented together by snow and ice. To make matters as bad as possible, the machinery for regulating the size of the coal was incomplete—the screens not being in use—so that the whole of it had to pass through the breaker, the teeth of which clogged by the small damp coal. Notwithstanding this, the retorts were for the most part charged satisfactorily; the exceptions generally being the bottoms in which the double bends of the charging-shoots occur. These gave at first a good deal of trouble, principally, as subsequent experience proved, through the extreme fineness of the coal.

It has been previously remarked that the furnace nostrils as first made were found too small; and it may perhaps be as well to mention the difficulty that arose through this. During the first few days the heats were well maintained; but then came a time of trouble. The use of the fine damp coal lowered the heats, and the charges were consequently not so well carbonized. Then, unaccountably, a set would get comparatively black; others quickly followed suit; and this for a short time gave unusual anxiety. Fortunately, the precaution had been taken to provide an opening about 12 inches square, closed by a tile, in the front wall, for the purpose of giving access to the nostrils. By taking out this tile, and substituting a frame fitted with a plate of mica, provision was made for examining the interior of the bed. Inspection soon revealed the cause of the trouble; and this was found to be simply the blocking up of the nostrils, more or less, with carbon—doubtless brought about by tar from the mouthpieces getting in with the fuel through the charging opening. The nostrils were cleared; and in all those furnaces that were not in action, they were altered to the size of those in the ordinary settings.

This difficulty having been overcome, and also that of the fine coal dust by altering the breaker, the heats were brought gradually up until the full charges were worked off in all the retorts. All was going on well, and the labour was partly organized, when it became evident that the shoot castings were too hot for them to endure for any great length of time. This was after about three weeks' work. Steps were immediately taken to reduce the temperature, in order to prevent mischief, and to give time for consideration as to the best means to be taken to rectify matters. Ultimately, the building-in of the shoot castings was modified in accordance with an alternative plan of M. Coze—viz., the filling-in was carried from the wall of the bed to the centre of the castings only, thus leaving half of the castings exposed; the central space of

about 6 feet between the beds, which had been filled in with rubbish and paved over with stocks, was cleared out; and the sides next the mouthpieces were covered with chequered plates for the men to work upon—the central portion being left open. A series of pigeon holes were made in the wall at the back of the shoot casting, opening out into this space; and by leaving these open, or by closing them more or less by loose bricks, some degree of regulation of the heat was secured.

As far as the actual charging of the retorts is concerned, a certain amount of discretion is necessary as to the mode of tipping the scoop, according as to whether a light or a heavy charge is required, and having regard also to the condition of the coal. A vital condition for the successful working of the Coze retorts is that they must be maintained at a temperature sufficiently high to burn off the charges thoroughly. The shoot castings must also be kept at such a temperature that any tarry matter that condenses in them is converted into a light soot, which is readily swept into the retort by the next charge of coal.

The author has been questioned several times with regard to the ascension-pipes: "Why are these put at the lower end of the retort—the gas having therefore to be pulled down from the upper end, whereas its natural tendency is to ascend, which would point to the upper end of the retort as the proper place from which to draw off the gas, when, too, only a short ascension-pipe would be necessary?" In reply to this, the author would say that, in his opinion, the lower mouthpiece is the proper one from which to take off the gas, for this reason: Liquor and tarry matters condense and collect in the lower mouthpiece, and gradually evaporate during the charge; keeping the ascension-pipe moist, and preventing stopped pipes. As to the drawing of the coke, if the charges are properly burnt off, this is very readily done; it being necessary, however, to insert a rod, flattened at the end in the form of a slice, to disturb it, when it easily slides out—the time actually taken in drawing being about half a minute.

The organization of labour for working these retorts gave, as can readily be imagined, no little trouble. The work was started on the eight-hour or three-shift system. The foremen and the men who applied for the work had been employed in the construction of the different branches of the new plant, and stoking was quite a new thing to them. A few sets only were put in action at first, so as to get the men used to the work; the number being gradually increased by a bed or two at a time, until 10 beds or 70 retorts for each gang were reached. At starting, it was found necessary to tell off two men from each gang to charge, as the Coze scoop-carriage was found to be very heavy to work when filled with coal. It is on very small wheels, and weighs 16½ cwt. empty, and when charged about 27 cwt. A gang consisted of four men—two on the stage to draw the retorts and feed the fires, at stokers' wages; and two on the top to charge, at a lower rate of pay. These did only a little more than 11½ mouthpieces per hour; and although the fires were fed in addition, the amount of saving was not at all satisfactory. Besides, the amount of work was not equally divided between the stage and top men. When taking into consideration the various requirements in connection with the work, a temporary line was laid in the yard, and an experiment tried with one of the Coze carriages, to ascertain the time required to fill the scoops, travel the average distance (which is about 22 feet), tip the charge, and return to the hopper. From this the author was able to form an opinion as to the time that was necessary; and he was also convinced that one man, sufficiently powerful to push the loaded carriages about with reasonable ease, would be able to charge a larger number of retorts than two men had been doing. But the author's desire was to have the whole of the work arranged so that any ordinary labourer would be able to perform it; and it was therefore advisable for some means to be devised for rendering the scoop-carriage workable by anyone.

The first idea was to adapt a lever, on the principle of the patent railway-waggon shunter, to the carriage. This answered the purpose so far as easily starting the load was concerned; but insufficient space was available for working the lever so as to get up the required speed. It was then determined to run a spindle through the length of the carriage, with a handle at both ends, and connected up to the wheel-axle by an upright shaft and two pairs of bevel-wheels—the pair on the wheel-axle and lower end of vertical shaft being equal, the other pair four to one. This was found to answer the purpose perfectly. Any ordinary man can now run the scoop-carriage about quite easily; and its position in front of the mouthpiece can be regulated with the greatest ease. The work was ultimately arranged as follows: One man on the top, at stokers' wages, to do the whole of the work of charging 14 retorts per hour; and two men on the stage, at stokers' wages, for drawing the same number—they being relieved of the work of poking in hot fuel and breezing up the feeding doors. This permitted of a very convenient way of arranging the work; retorts being opened in each set only once in three hours, and sufficiently frequent for the supply of hot fuel to the furnaces—each hour's work being, therefore, well concentrated.

The cost of labour, compared with the horizontal system of setting retorts, is shown below:—

System.	Men employed.	Wages paid.	Work done.			Additional Amount of Work done.	Wages per Ton of Coal.
			Mouthpieces.	Carbonizing.			
				Total cwt.	Cwt. per Man.	Per Cent.	s. d.
Horizontal retorts	1 scoop man 2 stokers	s. d. 5 7 10 8					
	3 men	16 3	72	216	72	..	1 6
Coze's inclined retorts	1 top man. 2 stage men	5 4 10 8					
	3 men	16 0	112	364	121⅓	68⅓	0 10½

Saving effected: 7½d. per ton, or 41·7 per cent.

It is believed that the maximum saving in labour has not yet been attained, and that experience and practice will result in further economy. Undoubtedly, the Coze settings are more costly than either the horizontal or other inclined systems; but the Kensal Green installation was decided upon under exceptional circumstances, at a time when there was no other thoroughly-tried plan of inclined retorts in operation, and the only alternative would have been to erect the retorts horizontally, as it was necessary for the extensions to be completed forthwith. In addition to the saving in the carbonizing wages shown above, there is another advantage of great importance—viz., the comparatively easy nature of the work, which brings it within the capabilities of an ordinary labourer.

The next system of working inclined retorts to be referred to is that invented by our President, Mr. G. C. Trewby,* which is in operation at the Beckton Gas-Works, applied to two ranges of beds, each range consisting of eight beds of nine retorts 15 feet long, set back to back, with a space of 16 feet between them. Like M. Coze's system, the object in view has been to ensure the rapid and easy charging and discharging of the retorts by gravity, and at the same time to ensure the charges of coal being evenly distributed with certainty over the whole length of the retort.

With regard to the discharging of the coke, the object is attained by setting the retorts at the angle of 38 degrees with the horizontal. At this angle the coke is very readily discharged. Upon the opening of the lower lid, it either immediately commences to slide out, or upon a very slight disturbance it will do so; the whole being discharged in the space of a few seconds. Of course, the success of this method depends, as in others, upon the charge being properly burnt off. A very ingenious stop, invented by Mr. Wren, of the Beckton works, is in use, to prevent the coal from descending below the heated part of the retort into the mouthpiece. This stop is attached to the retort-lid—the time and trouble of taking out and replacing a moveable stop being thus avoided; and as soon as the coke is discharged, the lid is closed, and the retort is ready to receive its charge of coal.

As regards the operation of charging, the inclination of the retort being so great, the disposition of the charge would be to run too freely to the lower end. In order to take advantage of the easy flow obtained by the adoption of this angle, and at the same time to ensure with certainty an even layer of coal of the proper thickness, Mr. Trewby introduces a flat steel plate into the retort, dividing it into two parts for its whole length; and the lower space is

* This system was fully described and illustrated in the JOURNAL, Vol. LVI., p. 251.

then readily filled up with coal, when the plate is at once withdrawn.

For charging the retorts, no machine in particular is specified or claimed in Mr. Trewby's patent; any convenient appliance can be used for the purpose. At Beckton, a machine patented by Mr. Ruscoe, of Hyde, has been adopted.* An iron stage has been erected in the 16-feet space between the beds, for the purpose of carrying the machine, and providing a platform for the use of the men opening and closing the lids on the upper end of the retorts. To furnish the power for working the machine, an endless cotton rope runs in the centre of the platform the whole length of the retort-benches; being driven by a winding-engine provided for the purpose. There is fixed at a high level at one end of the beds a large store hopper, into which the coal is raised by an elevator, having in connection with it a breaker through which the coal is passed. From this supply a small hopper attached to the machine is filled with sufficient coal to enable it to charge all the retorts in one horizontal line of eight beds. The machine appears to be very readily manipulated. It travels, as before stated, the whole length of the beds, and is then brought back under the large store hopper, replenished with coal, and the plate arrangement raised or lowered, as the case may be, to the proper level for the second row of retorts, when it is ready for another journey, and so on. The charging process is as follows: The plate is introduced into the retort at such a height as to allow space for the deposit of a layer of coal 5 inches thick between it and the bottom of the retort, which is Ω-shaped, 20 in. by 13 in. The bottom of the coal-hopper is constructed at the same angle as the inclination of the retort; and a measuring chamber, the whole length and width of the hopper, is formed immediately underneath. The bottom plate of the hopper is provided with three openings to allow of the passage of the coal into the measuring chamber, which at its lower end is provided with a sliding-valve, and at its upper end with a moveable taper wedge-piece, which can be lowered or raised to regulate the capacity of the chamber, and thus determine the weight of coal to be put into the retort. The mechanical movements for working this measuring chamber are automatic. As the sliding division-plate travels into the retort by rack-and-pinion and other wheel motions, three sliding-valves are forced along the bottom of the hopper through the coal, closing the three openings which communicate with the measuring chamber, as previously described. As soon as this has taken place, the attendant, by pulling a chain to which is attached a dead weight, raises the sliding-valve at the lower end of the measuring chamber; the charge of coal immediately falls down through a telescopic shoot, and through an opening provided for the purpose at the end of the division-plate which projects beyond the retort, and then through a shoot underneath and attached to the end of the division-plate, which conducts the coal into the retort. The charge having been delivered into the retort, the attendant raises the dead weight, thus allowing the sliding-valve to fall and close the outlet of the measuring chamber. He then puts the machinery in motion to withdraw the division-plate from the retort, and at the same time a fresh supply of coal is admitted into the measuring chamber by the automatic opening of the valves or slides previously described. Thus, by the time the division-plate is completely withdrawn and is again at rest, a charge of coal is ready for the next retort, to which the machinery is now moved on. In order to work the machine, the attendant has only to manipulate three levers placed side by side on the bed-plate, by which means the motions are obtained for traversing the machine backwards and forwards on the stage, for raising and lowering the division-plate, together with the carriage on which it slides, to the desired level, and finally for working the plate in and out of the retort.

The following table gives a comparison of the cost of working the system of inclined retorts just described and the horizontal system. In this case three men will carbonize the same amount of coal that can be done in the old system by eight men.

Systems.	Men employed.	Wages paid.	Work done.			Additional Amount of Work done.	Wages per Ton of Coal.
			Mouthpieces.	Carbonizing.			
		s. d.		Total cwt.	Cwts. per Man.	Per Cent.	s. d
Horizontal retorts	1 scoop man 2 stokers	5 7 10 8					
	3 men	16 3	72	216	72	..	1 6
Mr. Trewby's system of inclined retorts	1 engine-driver .. 1 driver for machine 1 lid-man 2 coke discharging men ..	5 0 5 6 4 5 8 10					
		23 9	192	960	192	166·6	0 6

Saving effected: 1s. per ton, or 66·6 per cent.

Reference will now be shortly made to the improvements on the Coze system of working inclined retorts introduced by Messrs. Morris and Van Vestraut.† These consist essentially in the use of a light moveable shoot in place of the built-in cast-iron one into which the retort is prolonged in M. Coze's arrangement. The latter is objectionable, both on account of its costliness, of its rendering one end of the retort inaccessible while in action, and of the large surface of the shoot which is in communication with the productive part of the retort, and which is only useful during the few seconds that the charge is being admitted, and any defect in which leads to most serious results. This objection is entirely overcome by the Morris and Van Vestraut plan; an additional and great advantage being that the ordinary-shaped Ω through retorts can be used.

The moveable shoot which allows of this improved system of working is constructed of thin steel, and is made telescopic, so as to be capable of adjustment to the variations in the levels of the retorts; the lower leg being hung by short chains to the upper one, and the height being regulated by these chains. At the bottom of the shoot is fixed an adjustable shoe, which projects into the mouth of the retorts and directs the coal into it. A screw arrangement is attached to the back of the shoot, by means of which the angle of the shoe is regulated according to the description of coal to be used and the height through which it falls; thus admitting it into the retort with the necessary degree of force for even distribution. Mr. Morris is of opinion that this system can be applied successfully to the charging of retorts 20 feet in length; and the author has seen it so applied in some experimental settings at Southall, where the charges were very evenly distributed. No doubt many of those present have also seen these experimental settings in action. The writer has been informed by Mr. Morris that the cost of carbonizing in the inclined retorts at Southall was 1s. 8d. per ton, as against 3s. 8d. per ton on the old style; and Mr. Morris considers that the alterations which are being carried out at Brentford and Southall (shown on the diagrams upon the wall), which were not received in time to be described in this paper, must lessen the cost of carbonizing, and lighten the labour of the men employed.

The Morris and Van Vestraut system has been adopted at the works of the Rochdale Corporation, applied to a bench of five beds of seven retorts 15 feet long. The coal in this case is delivered by cart into a pit communicating with the boot of an elevator, which raises it, after the large lumps have passed through a breaker, into a large high-level hopper, under which the small trucks for conveying it to the retorts are run. There is no attempt at mechanical breaking; the large lumps being broken by hand. At the back of the beds a light stage is fixed under the mouthpieces of the upper ends of the retorts, for an attendant to manipulate the moveable shoots and the retort-lids. For each tier of retorts a separate shoot is provided, the upper ends of which are opened out into a funnel shape for receiving the charges of coal; and from this enlarged end the shoot is hung or supported by small wheels which run on a line of rails extending the length of the beds. The charges of coal are brought over the shoots in small trucks divided into two compartments, provided with a bottom door, and containing one charge. The shoot, having been inserted in the mouthpiece, is held there while the coal is run in; and if the proper degree of resistance has been obtained by the shoe, the coal is distributed as in the Coze system. The attendant now withdraws the shoot, and moves it along to the next retort, closes the lid, and repeats the operation.

* This machine was described and illustrated in the JOURNAL for Jan. 6 last, p. 22.

† See JOURNAL, Vol. LV., p. 339; Vol. LVI., p. 1096; Vol. LVII., p. 647.

The last modification of Coze's system to be referred to is the method of charging inclined retorts adopted by Mr. Braidwood at Greenwich. Mr. Braidwood sets his retorts at an angle of 36 instead of 29½ degrees, with the view of obtaining an easier discharge of the coke; but the two settings of seven 15-feet retorts that are at work are furnished with the Coze shoot castings for conducting the coal into the retorts. To prevent the coal running too freely, Mr. Braidwood has designed and patented a special truck, which automatically delivers it in a gentle stream into the mouthpiece. He, however, desired to do away with the objectionable permanent coal-shoot to each retort; and for working in conjunction with his truck, he has devised a specially constructed shoot for delivering the coal with the proper degree of force for charging evenly the retorts at the particular angle at which they are inclined. An arrangement is fitted in the shoot for baffling the coal to the necessary extent. The shoot has a double bend in it similar to the double bend at the bottom retort of the Coze setting. This shoot has at present only been used experimentally; and it is intended to provide one to each row of retorts. Mr. Braidwood considers that, having determined once for all the necessary degree of obstruction in the shoot for each tier of retorts, the coal will be always deposited in an even layer.

The action of the charging-truck carries out in an admirable manner the object the designer had in view—viz., a very steady, slow, automatic tilting motion. The truck which, when empty, weighs about 12 cwt., and is capable of carrying two charges of 6 cwt. each, can be readily pushed about by one man. It consists of two tilting compartments mounted on a carriage; and it works as follows: Having been brought up to the mouthpiece of the retort that is to receive the charge, the movement of a lever lowers an iron shield down to the back of the mouthpiece—indicating whether the truck is in the correct position, and also acting as a guide for the coal. A bolt which up to this time secured a sliding bar, is now thrown out. The bar, being pushed forward, raises the door at the end of the truck; and when this is nearly opened to the full extent, it actuates a lever, and liberates the tilting compartment, which, being supported with its centre of gravity placed considerably forward from the point of support in the direction in which it tilts, would now tip suddenly forward, but that its back end is connected by a rod to the piston of an air cylinder, which allows it only to move in a very steady, slow, and regular manner, causing a corresponding retarded delivery of the coal. The shield is now raised, and the attendant brings the truck back quickly to the horizontal, as valves opening upwards are provided in the piston of the air cylinder; and by pulling back the sliding bar, the bolt drops automatically into position, and all is secure. The cylinder is fixed on the carriage under the truck on trunnions; so that it follows the motion of the tilting-truck without guides or connecting rods. The coal in the second compartment is now tipped into the next retort, and the truck run away to the store hopper to be filled.

At Greenwich the coal is lifted by cranes out of the ships into a hopper, from which the ordinary waggons are filled and run away to a hydraulic lift, by which they are raised to a line of rails running over a high-level hopper at the end of the retort-beds. The tilting-trucks run under this hopper to take in their supply of coal. The beds that have been set with inclined retorts are in two rows of four each, and a quadrangular railway, with a turntable at each angle, has been laid at the top of them, one end of the quadrangle running under the store hopper.

One of the first problems to be solved in arranging for an installation of inclined retorts, and one that is of great importance, is the best way to deal with the coal supply. The whole object in inclining the retort is, of course, to utilize the force of gravity both in the operation of charging and drawing; and instead of a store of coal being placed at a low level in front of the retorts to be lifted into them by manual labour as required, means must now be taken to provide a constant supply of coal at a height sufficient to utilize this force in each succeeding operation. This has been done at Kensal Green by erecting a series of four pairs of hoppers over the double line of tramway on top of the beds; and the scoop-carriages are run under these to take in their coal—a lever opening three sliding-doors in the bottom of the hopper over each of the three scoops. The question, of course, arose as to what means should be adopted to keep a constant supply of coal in these hoppers, both from the barges and from the stores. The ordinary manner of lifting the coal appeared to be out of the question—the tops of the hoppers being about 40 feet above the ground level; for the railway for conveying the waggons would have been situated in the roof, and much above the top of the coal-stores. Means had also to be provided for working the coal out of stores. It was at the same time considered very desirable, in dealing with it, to effect as much labour saving as possible. It was therefore decided to adopt a system of elevators and conveyors to deal with the whole of the coal distribution.

At one end of the retort-house, and separated from it by a roadway, there is a dock in communication with the Grand Junction Canal, from which the coal is received in barges of about 70 tons capacity. Upon the edge of the dock, in line with the centre of the retort-house, a hopper was built, the top being about 20 feet from the ground; and the coal is lifted into it as required, by either one or two locomotive steam-cranes, running on rails on the ground level, each working a Hone's patent grab, capable of taking at a lift about 18 cwt. of coal, or 40 tons per hour. The hopper is provided with two converging screens, one to each crane, formed of steel bars. The coal that passes through these screens is conducted into a spout, leading to the main tray conveyor; and the remainder falls down into the hopper of a 10-horse West's coal-breaker, made to allow 3-inch or 4-inch cubes to pass through, and which, after breaking, delivers into the same main tray conveyor. In order to keep the coal moving, a claw or rake, worked by a strap from the breaker engine, is caused slowly to pass between the bars of the screen at intervals. The main conveyor, into which the coal is delivered, is about 35 feet long, and passes under the roadway discharging into the main elevator boot. This elevator is of the double steel chain form, the buckets 24 inches wide, and capable of lifting 80 tons of coal per hour into a small hopper, which branches into three spouts delivering into the high-level conveyors. One of these spouts delivers into the main or centre conveyor, which extends along over the beds as far as the last pair of hoppers, and at a sufficient elevation to deliver into small cross push-plate conveyors; one being situated over each pair of hoppers. This main conveyor is about 330 feet long and 2 feet wide, with thin steel push-plates 2 ft. 8 in. apart, and capable of conveying about 30 tons per hour. The other two spouts from the elevator hopper deliver right and left into two tray conveyors leading to the coal-stores, and delivering into two push-plate conveyors, which run the whole length of the two ranges of stores. Each of these latter is about 370 feet long by 18 inches wide, and of a capacity of 25 tons per hour, and is provided with a series of trap-doors for allowing the coal to fall into any part of the stores desired. The small cross conveyors previously referred to are capable of having their direction reversed. They are for distributing the coal in the hoppers. When it has dropped through the first trap-door, and has mounted up to the bottom of the conveyor, so that no more can get through, it passes on to the next opening; and so on, until one hopper is filled, when, the direction being reversed, the same operation is repeated with the other hopper.

The whole of this arrangement is for unloading coal out of barges, and distributing it into the store hoppers and stores. It now remains to describe the means adopted for transferring the coal from the stores to the hoppers. For this purpose a tunnel, 6 feet by 6 feet, was constructed under and in the centre of each range of coal-stores, and for their whole length, and a push-plate conveyor, of similar design to those for filling the stores, was laid down the whole length of the tunnel. In the centre of each compartment into which the stores were divided, a funnel-shaped casting was built in; penetrating the tunnel arch, and terminating in a spout for admitting the coal into the conveyor for delivery to the elevators. There are two of these elevators to each tunnel, for raising the coal into the hoppers on top of the beds; thus two pairs of hoppers are charged from each range of coal-stores. These long conveyors have been arranged to travel in one direction only; and it will be seen that if there were only one for the whole length of the tunnel, there would be no means of working the coal out of the end stores that are situated beyond the last elevator on each side. To get over this difficulty, each of the tunnel conveyors was made in two parts—in

fact, as two separate conveyors, one extending from the front or driving end of the building to the farthest elevator pit, for dealing with all the coal-stores between these two points, and a short one working in the opposite direction for bringing the coal from the end stores to the elevator; the change of direction being obtained by driving the short conveyor from the long one by the interposition of suitable spur-wheels.

There being only one elevator to fill each pair of hoppers, the small cross conveyors previously referred to are utilized for distributing the coal therein. The whole of the conveyors, &c., are driven by means of gearing fixed inside the front wall of the retort-house. The main shaft is of steel 4½ inches in diameter, provided with all the necessary wheels, vertical shafts, fixings, &c., and the whole is put in motion by a Galloway compound condensing engine of 120-horse power, situated in an engine-house built at one side of the retort-house; a duplicate engine being fixed on the opposite side of the building. A clutch-box is provided on the main shaft close to each engine, so that either will drive the whole of the shafting, according to the position of the clutches. Clutch-boxes are also provided for throwing in or out each of the long conveyors. The side elevators and small cross conveyors are driven by straps from pulleys fixed on shafting which runs along both sides of the retort-house to the farthest elevator on each side. These shafts are driven off the main shaft, and commence at 3½ inches diameter, decreasing to 3 inches; that on the side of the farthest elevator being again decreased to 2½ inches. Altogether, there is about 800 feet of shafting. The combined length of the conveyors is 2035 feet; and of the elevators, 292 feet. These are the working lengths; of course, including the return, they would be doubled. The author intended to take a complete set of indicator diagrams, showing the power required for working the different parts of the machinery; but up to the present time he has only obtained a part of them, which are tabulated in the Appendix. The whole of the breaking, elevating, and conveying machinery, excluding the cranes and grabs, and the masonry, brickwork, and girder work, which was done by the Company, was carried out by the New Conveyor Company, of Metal Exchange Buildings, London.

There are one or two points in the working arrangements that may be of interest. First, the spout for drawing the coal from the stores into the tunnel conveyors did not work well; requiring such constant attention that it could not be left for a minute. If the slide for regulating and cutting off the supply was withdrawn altogether, the feed of coal was too large to be taken away by the elevator; and upon partly closing it, it would continually choke—thus cutting off the supply. An experiment was tried by fitting a flap or hinged door to the bottom of the spout, which was brought down so that the push-plate of the conveyor would lift up this door; thus shutting off the supply of coal. As the push-plate passed away, the door fell open, to be again shut by each push-plate in succession. This was still found to give too large a feed. Finally, the following arrangement was devised and found to work well. An arm or bracket was fixed to the spout, and a hinged bar was secured to the door or flap, and projecting beyond it to the necessary distance. When the conveyor is in motion, the push-plate lifts up and closes the door quickly; and as it moves on past the latter, it is still kept shut by the bar pressing against the bracket. As soon, however, as the bar is liberated, the door falls open to the full extent—the hinge in the bar allowing of this. This arrangement overcame the difficulty of drawing off the supply of coal from the stores, while only a few of the special doors are required, as they are moveable.

Another point of difficulty arose in connection with the filling of the stores. There is a trap-door in the bottom of the conveyor over the centre of each store, a compartment of about 21 feet square by 30 feet deep. The coal in falling formed a long cone, the large pieces separating out and rolling down to the bottom of the heap; the centre part being composed of all the finest coal pretty well compressed. In emptying a store filled in this manner, the fine coal was delivered first, so that a hopper would at times be completely filled with fine coal; thus causing trouble in the retorts. This difficulty was overcome by placing a hood under the trap-door for the coal to fall upon—the hood being formed by the intersection of four inverted troughs; the coal being conducted down the angle of intersection, and thus forming four conical heaps instead of one, the lumps falling in all directions.

The arrangement for filling the travelling scoop from the store hoppers may perhaps be worthy of description. There are three long narrow scoops, placed side by side, to be filled; and as the hoppers are situated over the line of rails upon which the scoop-carriage works, the height from the rail to the bottom of the hopper must be sufficient to allow the scoop to be tilted at this particular spot, when charging the retorts, and also for the charging man to pass under. Each scoop is filled from the hopper by the opening of three sliding-doors, 12 inches by 9 inches, by means of a lever. When the scoops are in their horizontal position ready to receive the charge, there is a considerable distance of this to fall through, and a permanently fixed shoot is inadmissible for the reasons stated. Therefore a very short shoot was fixed for the whole length of the three discharging openings, and from the edge of this shoot a swinging flap was hung; the flap being so balanced that, when not required for use, it remains in a horizontal position, allowing room for the tipping of the scoop, &c.; and when required, by just pulling it down, it remains at the proper angle for directing the coal into the scoop.

The total cost of the coal-distributing machinery was, in round numbers, between £13,000 and £14,000; and the estimated cost of working, taking the maximum daily consumption of coal at 300 tons, is as follows:—

		s.	d.	s.	d.	
One engine-driver	1½ days at	5	6 =	8	3	
One attendant oiling	1½ „	4	6 =	6	9	
Two men, each	½ day at	3	6 =	3	6	
300 tons costing		18	6 =			0·74d. per ton.
Crane driver						0·36d. „
Men working grab						0·60d. „
Total cost per ton of coal						1·70d. per ton.

At the time the adoption of the conveyor system was determined upon, the average cost of lifting and distributing the coal to the old retort-house and to and from the coal-stores was about 6d. per ton of coal; so that there is a large margin to provide for the cost of repairs and fuel.

In comparing these different systems of working inclined retorts, favourable and unfavourable points will be noticed in connection with each. In the discussion which it is hoped will take place, these points will probably be brought out and considered in a far more able manner than the author has attempted; and he will therefore conclude with the expression of opinion that the eventual outcome of the activity now being displayed in connection with this subject will be the evolution of a greatly improved system of carbonization, beneficial alike to shareholders and workmen.

[APPENDIX.]

Indications of 120-Horse Power Galloway Compound Condensing Engine working at 90 Revolutions per Minute, with a Boiler Pressure of 80 lbs.

	I.H.P.
No. 1.—Friction diagram taken with the whole of the shafting running	39·1
No. 2.—With nearly half the shafting thrown off, but the tray conveyor under load; the main elevator, two of the long push-plate conveyors, one front cross conveyor, and one small cross conveyor running empty	50·8
No. 3.—The same as No. 2, but lifting and conveying 40 tons of coal per hour	67·4
No. 4.—Friction diagram taken with one long push-plate conveyor over coal-stores, and the largest part of one of the combined tunnel conveyors running empty	39·2
No. 5.—Tunnel conveyors as in No. 4, one side elevator and small cross conveyors, conveying and elevating about 20 tons per hour	35·3

A vote of thanks was unanimously accorded to Mr. M'Minn for his paper.

The PRESIDENT said there was still time for some discussion of the paper, and he invited remarks.

Mr. C. C. CARPENTER (Vauxhall) suggested that it would be more convenient if the discussion were adjourned until after the members had visited the Kensal Green Works in the afternoon.

Mr. MORTON said he should not be able to go to Kensal Green; and therefore he would be very glad to have a little more information as to the division plate in the retorts which formed a feature in the arrangement adopted at Beckton.

Mr. J. Ruscoe (Hyde), with the aid of diagrams on the wall, explained the action of the plate. He said it was supported by, and moved on the carriage, which had guides through which it worked, and was lowered into the retort and withdrawn by means of a worm-wheel and chain, which could be reversed. There was also provision for raising or lowering it, so that the space underneath the plate, into which the coal was fed, might be enlarged from 5 inches (the minimum) to 7 or 7½ inches. The plate was perfectly flat, and had a piece of T-iron at the top, to strengthen it. It was about 16 inches wide for a 20-inch retort; and it was kept in position simply by the guides in the carriage. It was not found to become heated; the cool coal introduced under it preventing any such effect. The weight of the plate and carriage was about 7¾ cwt.; but he hoped this would be reduced. He also explained the operation of other parts of the machinery, as shown in the diagram.

The meeting then adjourned till the following day.

The President took the chair at half-past ten on Wednesday morning, and at once invited discussion on Mr. M'Minn's paper.

Mr. J. F. Braidwood (Greenwich) said that, at the Greenwich station of the South Metropolitan Gas Company, they had had some months' experience with these inclined retorts, and were fairly well, but not quite, satisfied with them. They were, however, making alterations, which it was hoped would render the system more effective. The inclination he adopted was 36 degrees; and, by a simple arrangement of tilting the truck, they were able to get the coal fairly well into the retorts at this angle. But it was not so satisfactory as they had expected. They were now working six more sets of seven retorts; and they looked forward to getting some very good results. He fully endorsed what the author of the paper had stated with regard to the saving being quite 50 per cent. on the labour; but he should like to ask him whether, in his comparison of the cost of the ordinary way of getting coal into the store and placing it along the retort-houses, he had taken into consideration labour only, or had included wear and tear and interest on capital.

Mr. J. Methven (Nine Elms) remarked that his experience of the working of sloping retorts on the Coze system had not been of quite so rosy a character as the author had described. It was not to be inferred that he was absolutely dissatisfied with the system; but it was right to remark that he did not arrive at all times at quite the same figures as those which had been given. He understood that the cost at Kensal Green was something like 10d. per ton for labour alone. So far as his experience went, it was about 1s. 1d. per ton. He had found that it was necessary to incur this expense in order to keep things going right, because they did not always do so. Notwithstanding this, there was a considerable saving in labour. That, however, was not the only thing. The great advantage attending the use of these settings lay in their simplicity of working. When they were started, quite raw hands were put to work them; and no difficulty whatever was experienced. The installation at the Nine Elms works was on the Coze system pure and simple; and there was a considerable disadvantage attaching to it, inasmuch as they were compelled to shift the coal so much. With horizontal retorts, the coal would have been disposed all along the retort-house on either side, within reach of the stokers. But to get it on to the top of the bench, it had to be shifted into the elevator; and this entailed considerable cost, which must be borne in mind. He had not been so fortunate as Mr. M'Minn in the matter of machinery for dealing with the coal. Undoubtedly, with such an elaborate system as they saw at Kensal Green on the previous day, the expense would be largely reduced. He believed that the figures given only dealt with the actual cost of labour attending the machines; and, of course, when the capital outlay was considered, and an amount put aside for interest and wear and tear, it would probably be found that the expense of one system was as great as that of the other. The wear and tear of such machinery would be very heavy. In the figures he had worked out roughly, he had put it down at 5 per cent.; but he was inclined to think that 10 per cent. was much nearer the mark.

Mr. Charles Hunt (Birmingham) said, so far as his experience went, he thought very favourably of the system of inclined retorts. When the subject first attracted his attention, it occurred to him that it was adaptable to retorts of much greater length than those used by M. Coze; and he at once commenced designing a setting that would utilize his existing retort arches, which were 20 feet in length. It seemed natural that the coal should be introduced at one end, and the coke drop out on to the floor at the other; and he did not hesitate to recommend a trial setting of retorts that would be 20 ft. 9 in. long from end to end, which it was contemplated could be charged by means of an ordinary hopper with an elongated shoot. He had not then seen the Coze system in operation, nor did he know what was being done at the Southall Gas-Works; but the trial was so far successful that they were now extending the system to thirteen more beds, making fourteen in all. The settings were of nine retorts each, within the same space as was formerly occupied by the horizontal retorts. He did not find any difficulty in introducing in a few seconds about 9 cwt. of coal per charge; but there were certain conditions to be observed. Some retorts could be charged much more easily than others; and this he attributed to a certain amount of unevenness—perhaps a little standing up of the joints—which would have to be avoided in future. The same difference was noticed when the coke was withdrawn. Some retorts were much more even than others; and from these, when the lids were opened, the coke poured out—assuming, of course, that it had been thoroughly burnt off. It required very little disturbance; and certainly the objections which were foreseen to the greater length of the retorts, were not found in practice. Of course, one had to consider what would be the ultimate saving; and he was bound to say that the economy obtained by means of machinery would, at any rate, run the Coze system very close indeed. The figures given by the author showed that a reduction had been effected from 1s. 6d. to 10½d. per ton by means of the arrangement they saw the previous day. This was a little in excess of the cost of drawing by machinery and charging by hand. So that, as compared with that system, there was really no saving. But there was this great advantage, that the simplest possible machinery, or next to none at all, would be required; and this was an important consideration. If the inclined system were adopted, this point should be kept steadily in view, and no more machinery, or none of a more complicated character than was absolutely necessary, should be introduced, otherwise they might just as well retain the horizontal retorts with the best system of machinery at present available. With regard to the arrangements at Kensal Green for the purpose of unloading and distributing the coal, everyone must admire them; but, at the same time, one felt rather dismayed at the cost. In all these matters, not only must reduction of labour be kept in view, but the ultimate expense of the operation; and if to the cost of labour they added interest on the outlay at 5 per cent., and depreciation at 10 per cent. (which was not too much for machinery of this character), he estimated that there was a loss, as against hand labour, of something like 3d. or 4d. per ton of coal carbonized. Other considerations might weigh in adopting such a process in preference to the employment of a large quantity of labour; but the ultimate cost must be borne in mind. He added that the angle of his retorts was 29 degrees.

Mr. C. C. Carpenter (Vauxhall) expressed the intention of dealing only with the system of elevators, grabs, and conveyors. The author of the paper had, he said, given 1·7d. as the total cost per ton of coal delivered into the hoppers from the stores; and he went on to say that the cost previously was about 6d. per ton. He (Mr. Carpenter) thought this comparison was not, perhaps, quite so fair as it might be, because the author compared getting the coal out of barges by hand, and filling by hand, in the one case, with conveying and grab gear in the other. If the expense of lifting the coal from the barges by means of grabs and elevators, and lifting it with a crane, tipping it into hoppers, and running it into coal-stores by trucks, were taken out, the work could be done for 1·96d. per ton, because it was evident that the cost of the crane-driver would be the same, 0·36d., and that of the man working the grab the same, 0·6d.; and if 1d. were added, to cover the cost of getting the coal from the hoppers into the retort-houses, it would, if anything, be above

the mark. In that particular house, which was very favourably situated, the cost would be only 1·96d. per ton. It therefore appeared that the saving was merely 0·26d.; and this might fairly be balanced by the extra fuel required to drive all the elevating gear. Then the comparison became one between an outlay of £13,000 or £14,000 and one of about £1500; so that it simply meant a very much heavier capital expenditure for this conveying gear than would be necessary in a simple system of running coal into the stores by means of trucks. He had not had any experience with regard to inclined retorts.

Mr. VAN VESTRAUT (London) explained that the elevating of the coal could be done in some cases by having a railway truck, and tipping the contents down into the hopper. The cost of working the retorts at Kensal Green, where the system was very well carried out, would, he said, be about £50 per retort; but the same effect could be obtained by the plan shown at the Nine Elms works for about half the cost—viz., £25 per 10-feet retort. The proper angle depended very much on the velocity with which the coal was thrown in. With a very low angle, considerable velocity was required; if it were greater, the coal must be tipped in slowly.

The PRESIDENT asked Mr. Van Vestraut if he had had experience of any installation actually at work.

Mr. VAN VESTRAUT said that he believed the average economy in the cost of labour was about 50 per cent.; but up to this time, there had been no real test as to the figure at which the retorts could be worked. In one case (not a gas-works, but a private company, whose name he was not at liberty to mention), they were working the ordinary retort system at a very low rate—only paying the men 3s. 4d. a day, and each man worked 4½ tons of coal; making the cost of carbonization by hand labour only 10d. per ton. They were working direct from a railway siding into a hopper; and the lifting of the coal from this came to 0·78d. per ton. The cost of charging and drawing the retorts was about 2½d. per ton. In that case it was to the personal interest of the firm to do things themselves, and to do them exceedingly cheaply; and the whole operation, so far as he could gather, did not cost more than 5d. per ton. This was infinitely cheaper than the work could be done for at any gas-works, where, as a rule, men did not carbonize more than from 2 to 3 tons per day. It was at a chemical works in the Potteries; and he understood that, when the men struck for eight hours' work, the firm discharged the whole of them, and engaged fresh hands without difficulty, In that case the cost of the installation of inclined retorts came to £42 per retort of 15 feet. This did not include a roof for the building, which was of galvanized iron. It was the cheapest installation for carbonization he had yet seen. The angle adopted there was 33 degrees; and the coke came out without any trouble. This, however, was simply a question of heat. If the coke was properly burnt off, it came out freely; if not, it adhered to the sides of the retort, and there was considerable difficulty in withdrawing it.

Mr. A. COLSON (Leicester) had not had any experience in working inclined retorts, and therefore said he should like to ask those who had, whether or not they were likely to continue to work satisfactorily after they had been some time in operation. With horizontal retorts it was difficult at times to withdraw the coke when they had been at work for twelve or eighteen months; for, becoming very uneven, there would necessarily be a good deal of trouble getting out the charges. He should suppose this might occur with inclined retorts, which would also become uneven.

Mr. VAN VESTRAUT said that there was no more trouble in working these than ordinary retorts. Supposing there was a hollow of 1½ or at the outside 2 inches in the middle of the retort, it was possible, with one pattern of setting, to get at it from either end for repairing purposes; and even if it could not be repaired, it simply meant a couple of inches more coal getting into that place. This, if it happened to be in the middle of the setting, was rather an advantage than otherwise. There was, in fact, no difficulty with regard to repairs. Perhaps the inclined retorts were not quite so easy to mend as horizontal ones; but no trouble had been experienced hitherto, except with the first pattern. There was really not so much wear and tear from tools going in.

Mr. T. MAY (Richmond) remarked that, not having had any experience with inclined retorts, his observations would apply more to the time it took to charge them than to the working of them. He said he noticed on the previous day that there were four men at work—not three as mentioned in the paper. One man was poking in the fuel, while another was clearing the pipes; and they took something like 25 minutes to charge 14 retorts. In his own case, where they had in use West's manual power machinery (which had worked very simply, without any break-down, from year's end to year's end), four men charged 100 mouthpieces, and 14 retorts took, generally speaking, about 14, not 25 minutes. So that this system seemed to him to be a retrograde movement as compared with West's manual power machinery. He should like to know if the working life of a Coze retort had yet been ascertained.

The PRESIDENT asked if Mr. May could give the cost of charging and drawing.

Mr. MAY replied that the four men also attended to the fires and furnaces. He could not give the cost per ton; but it could be worked out from the fact that the men were paid practically the same rate as the men in the other case. The charges were 2½ cwt. each.

Mr. G. LIVESEY said he was much struck by the last sentence in the paper: "The eventual outcome of the activity now being displayed in connection with this subject will be the evolution of a greatly improved system of carbonization, beneficial alike to shareholders and workmen." It rather puzzled him to see how it could be beneficial to the workmen when, according to the figures, it was going to displace two-thirds of them, and give them no work at all. No doubt the author of the paper referred to the kind of work they were called upon to do; and *à propos* of this, he might quote what was said to his brother some time ago by one of the stokers at Greenwich, who objected to go into the yard to do navvy work. He asked him why he objected; and he replied: "You see, I have not been accustomed to hard work"—showing that he very much preferred the retort-house to the ordinary work in the yard. In fact, there was a great deal of nonsense talked about retort-house work, as that instance showed. Many men preferred it; and during a great part of the year, the retort-house was unquestionably the most comfortable place in a gas-works. Another proof was the long period that men continued to work there. At the time of the South Metropolitan strike, many of the men who had been with them twenty or thirty years—all the time in the retort-houses—left them; showing that it could not be such dangerous or difficult work as was made out. One of the great troubles of the present day was to find work for the people; and he must confess to a certain amount of regret at the introduction of machinery, whereby a healthy and remunerative class of work would be taken from men. He would much rather have seen men doing their work in the happy and contented manner they used to do; and that work might have been continued to them. However, those days seemed to be passing away very rapidly; and consequently to machinery they must come. They had been trying it for the past twenty or five-and-twenty years; and the workmen would have to understand that it would have to come. He had lately met with a very good story about some dogs hunting a beaver; and the narrator said the beaver ran up a tree. "Oh," remarked somebody who was listening, and who understood the habits of beavers, "but beavers cannot climb trees." "Well," said the story-teller, "that beaver had to." So it might be said that machinery could not draw and charge a retort; but machinery would have to do it, somehow or other. What struck him, looking at all this, was that they were going on the wrong track; they were increasing complication when everything should be simplified. Mr. Hunt had touched upon that point, and spoken about simple machinery; and this was the end that should be kept in view. He could not say very much about inclined retorts, though he had seen them; but with regard to the drawing of the charges—putting up the slice and "tickling" the coke—it was nothing, as regards simplicity and ease, to be compared with the new form of Mr. Foulis's hydraulic machine, which had been very much improved from the original one introduced some years since. With this the retort was drawn with the greatest ease; and the machine was very light and cheap. The mistake made in drawing and charging machinery hitherto had been that it had been so dreadfully heavy. If the inclined retort system could

not be simplified, it would not hold its own against ordinary machinery, such as that to which he had referred, for drawing; and he understood that Mr. Foulis was now preparing a machine for charging which would probably do the work in as efficient a manner as the other. If this could be introduced, there would be a great saving in labour; and it would still be in the direction of simplification. The instance which had been given by Mr. Van Vestraut only illustrated what he said at the beginning, that the work of the gas stoker was not so hard as was represented, when they found that these men were able to do so much work for so little money. He sincerely hoped that machinery would be adopted; his only ground for expressing that hope being that the workmen had shown themselves so intractable and unreasonable, that there was no alternative but to introduce machinery and make themselves independent. He said this with great regret, because he would much rather see some system introduced whereby the workmen should be happy and contented, and Capital and Labour—employer and employed—work together with a hearty good-will for the benefit of both.

Mr. W. Foulis (Glasgow) said he was not prepared to speak on the subject of inclined retorts, bu the had always felt that any mechanical appliance, to be successful in a retort-house, must be very simple; for no complicated machinery, however well it might work at first, could stand the wear and tear, and the dust and dirt, of the place. Nor did he think complicated machinery was proper for such purposes. What he had felt all along with regard to inclined retorts was, that it was probably comparatively easy to set a retort at such an angle as would suit works where only one class of coal was used; but in works such as his, where forty different varieties were employed, and scarcely two alike—some being fine, almost like Newcastle, and others as round as cannel—it would be hopeless to attempt to have a series of retorts placed at an angle that would suit all these varieties. He added, in answer to the President, that he could not at the moment give the cost of charging and drawing by his hydraulic machine.

Mr. Van Vestraut observed that, comparing the cost of charging by machinery with that of the inclined system, it must be remembered that in the latter the coal had only to be dropped into the retorts; and there was no limit whatever, so far as it could be tested, to the amount which could be put in. A man could charge 7 cwt. as quickly as 3 cwt. At the present time the retorts were being made larger; and there was a possibility of being able to put in a ton of coal in the same time as they now put in 4, 5, or 6 cwt. The complication alluded to was only in the case of one setting. At the Brentford Gas-Works, as well as in other places, there was no machinery attached at all. He could not give the actual cost of carbonizing under the system. The Morris and Van Vestraut shoot was only a light steel one, which did not belong to the setting in any way. It was merely a pipe which could be attached to a truck or barrel. In some cases they had simply taken off a man's back coal in sacks, and tumbled it into the shoot—four, five, or six sacks—and it fell into the retort, and was distributed in an even manner. There was no more outlay or difficulty with that kind of setting than there was with the present one; and rather than go to the expense of complicated machinery, it seemed to him advisable to adopt a simple form of this character. With regard to the various classes of coal, if there was sufficient force at first to deliver the coal which caused the greatest friction, to the bottom of the retort, it was always possible afterwards, by an arrangement of the bottom of the shoot, to break or diminish the fall of the remainder, so that it might only just slide in.

Mr. F. T. C. Linton (Leith) said he thought one point which should be borne in mind was the conditions of working. The system at the upper end should be tolerable to flesh and blood. That was impressed on his mind on the previous day, when he was on the top of the retort-stack. He thought a single setting of retorts, open at both ends, would bring this about in a very much better way than a double set, whereby the men were exposed to the intolerable heat which was experienced at the top of the retort-bench.

Mr. T. Goulden (Beckton) said his experience had been with retorts set at a much greater angle than anything shown on the diagrams before them. As far as he could learn, with all the retorts on the Coze system and Mr. Hunt's system, there seemed to be considerable trouble in getting the coke out. With Mr. Hunt's 22-feet retorts, this would be a very great difficulty indeed. All his retorts were set at an angle of 38 degrees; and the coke came out perfectly free when it was burnt off. That was a *sine quâ non* to the discharge of any of them; and with the greater angle at which they were set, they had provision for that wear of the retort and sinking of parts which had been previously mentioned. Any little bulging at the bottom would not affect the flow of the coke from the retort, on its being opened, so much when it was set at a greater angle. At the same time there was a difficulty, with small rough and dry coals, in getting an even layer in the retort, unless they used the plate invented by the President. He hoped some time ago to be able to do without the plate at Beckton; and he made a great many experiments for the purpose. At first he met with some success; but, owing to the varied classes of coals, he found they had to go back to it. Instead of shortening the plate, and cutting it 2 feet from the stop, they now put the plate the whole length of the retort. This was a great feature, in all these systems of inclined retorts, as far as regarded the men. The coals coming under the plate need not be handled so carefully in putting in; but without this the men would require a great deal of supervision during the charging. With the plate, it did not matter how quickly the hopper was opened; down came the coal underneath the plate in a beautiful thin layer. With respect to the time of charging, with their somewhat crude apparatus (as he considered it) at Beckton, they charged a row of 24 retorts in 20 minutes; and they had to keep the men back from opening the door to discharge the coke. Otherwise, instead of "tickling up" the coke, it would tickle them up, it came out so quickly. He quite agreed that the object should be the simplification of apparatus; and if they could do without any at all, it would be better than the simplest that could be used. They employed none whatever. The men opened the door, and (provided the charge had been burnt off) they simply had to loosen the front coke with a chipper, and then the whole lot came down. He could entirely bear out what Mr. M'Minn had stated as to the cost.

Mr. Foulis said, as near as he could run out the figures, the cost by his machine for drawing and charging was from 8½d. to 9d. a ton; the charging being done by hand. He might add that he had the pleasure, a few weeks previously, of seeing the inclined retorts at work in Birmingham; and he must acknowledge that the 22-feet retorts seemed to be as easily drawn as the much shorter ones the members saw at the Kensal Green works on the preceding day.

Mr. M'Minn, in reply, admitted that it was quite true, as remarked by Mr. Braidwood, that the cost of the wear and tear of the machinery was not included. In adopting the figure of 6d. on the old system, he thought it was very low; but it was only taking a regular supply of coal and putting it into the store, not taking it out again, except for convenience in the summer time. It was also dropped at a low level, not raised to the same height as was necessary with the inclined system. In fact, it was a figure which in many works would be reached in simply putting the coal on the stages. With regard to the wear and tear, he had not at present had any experience of this kind of machinery; but he thought 55 per cent. would be quite high enough. Before putting up the machinery, they inspected a conveyor on the same system, and had a very favourable report upon it; being informed that the wear and tear cost next to nothing, and that it had been at work for seven years without having had anything more than a few shillings per annum laid out upon it. He therefore hoped that this item would not be excessive. He thought Mr. Carpenter's comparison was not any fairer than his own, because he took it that, with any other system that would have to be put up for dealing with the coal, there would only be the carrying plant to provide, whereas there would be the expense of the platform, the conveyors, and the railway; and that would not deal with the question of the stored coal, which was very important, and must be taken into consideration. Lifting the coal out of the store economically would be a very important matter; and in the system which he had described, this

was done quite as cheaply as unloading it from the barge. Having to remove the coal into or out of the store did not add to the cost at all. In comparing the two systems, it must be remembered that the coal had to be raised to a much greater altitude in the case of inclined retorts than in the ordinary system. With regard to the charging of these retorts, it was certain there was a difference in the difficulty experienced in getting an even layer of coal according to the description used. Very fine coal was more troublesome to deal with in one way, and required tipping in with more force, so as to spread it evenly over the retort, than was the case with nutty coal, which required to be tipped in more slowly; otherwise there would be too thick a charge at the bottom, and too little at the top. In the case of very fine coal, there was more liability for the retort to choke up at the top. Nuts had to be put in very steadily and slowly indeed. The coal for the centre retorts in the Coze setting always required to be tipped in very slowly indeed, otherwise the greater fall caused it to descend too much to the bottom. In the bottom retorts, the double bend overcame that difficulty; and the coal went into them very well by tipping the truck as sharply as possible. The top retorts required the coal to be tipped in more sharply than the middle ones Practically speaking, the charge could be got in very well —as a rule, quite as well as in the horizontal system; for even in that case sometimes the centre of the retort, where the coal was most wanted, was found to be charged too lightly.

The PRESIDENT, in closing the discussion, said he would only add a few words with reference to inclined retorts. It struck him that there would be a difficulty in getting out the coke; and it was with this view that they put the retort at an angle of 40 degrees. It was kept going day and night for six months before trying the system on a larger scale; but the whole number had now been at work about twelve months, taking five charges every 24 hours. He quite agreed that the more one could simplify machinery in a retort-house, or even do without it, the better; but he did not see how inclined retorts were to be charged with any degree of regularity or certainty without some precaution. One might get the proper angle for a certain class of coal, and then things would be all right as long as this class was kept to. But in their case they had twenty different kinds of coal; and the angle which might suit one would not answer for another. He was responsible for recommending the adoption of the coal-distributing plant at Kensal Green. It was done at a time when they were at the height of their labour troubles, when the cost of labour was going up by leaps and bounds, and they did not know where they should be landed. It must be borne in mind that the machinery not only dealt with coal brought from the barges, but also with it as taken out of the store. In those works something like 30,000 or 40,000 tons of coal were put out of doors; and the object was to get it into the retort-house as economically as possible. It could be brought, by means of little engines and trucks, to the coal-lifting apparatus, and then distributed wherever it was wanted. He knew from experience as to the cost of handling coal at their different stations, that 6d. per ton was a very small matter. It would only provide for getting the coal out of the barges and placing it in the store. They had to pay the men in the barges 4d. a ton for filling the buckets—and then there was the crane-driver, and the men wheeling trucks; so that, altogether, the amount came to 6d. per ton. In some cases where the coal was in large stores, and there were no means of banking it out, they had to pay as much as 9d. and 1s. a ton. Therefore, taking all things into consideration, he believed there would ultimately be a saving. With regard to wear and tear, before deciding on this machinery, he went to some large sugar-works on the Thames, where they had a coal-grab at work, and one of the push-plate conveyors, which took the coal some distance into the works; and the proprietor assured him that the cost of wear and tear was merely nominal, though the machinery had been at work for seven years. He did not see what there was to wear out. It was really this consideration which led them to decide on making an experiment upon a large scale.

It was then announced by the PRESIDENT that the next three papers in the list would be read in succession, and discussed together.

Mr. T. GOULDEN (Beckton) read the first of these papers, entitled—

A FEW NOTES ON CARBURETTED WATER GAS AT BECKTON.

Before proceeding to lay before the members of the Institution details of the manufacture of carburetted water gas at Beckton, it may be well to mention that the object in adopting it was not so much to supplant existing methods of gas manufacture, as to have a section of the works which is capable of, at as small a cost as possible, turning out a sufficient quantity of gas of high illuminating power for admixture with common gas in the proportion found necessary to ensure the delivery of gas of about 17-candle power from the works.

It may be in the minds of members present that our esteemed President, Mr. G. C. Trewby, visited the United States in 1889; and over there he thoroughly studied the working of the different systems of water-gas plant employed in the manufacture of illuminating gas. Consequent on this inquiry, the plant finally decided on for erection at Beckton was the form known as the "Improved Lowe"—an apparatus apparently eminently adapted for dealing with varied classes of oils, both from the scientific method of its construction, and the admirable arrangement of its working parts, which render this apparatus so easy of manipulation as it is. This, although protected by patent rights in America, is not so here, to the best of the writer's belief. A section of plant on this system was erected at Beckton for the manufacture of 1,000,000 cubic feet of gas per day by the United Gas Improvement Company, of Philadelphia, in the beginning of this year, and on this apparatus mainly the statistics hereafter given have been arrived at.

There are, generally speaking, in use in America three classes of carburetted water gas processes: (1) Retort processes—viz., those in which the carbon for the decomposition of the steam is contained in retorts fired externally. (2) Generator processes—viz., those where the carbon for the decomposition of the steam is heated by its own combustion, and where the carburetting of the water gas is a second operation taking place in separate superheaters or retorts, heated by a second fire. (3) A modification of the second class, in which the carburetted water gas is made in a single operation; the gasification and fixing of the oil taking place simultaneously with the manufacture of the water gas in one apparatus heated by the generator fire. To the last of these processes belongs the improved Lowe; and it will be at once seen that great economy in fuel must result in the use of this apparatus against any processes of the first two types, since the heat which is in those blown away as waste, necessitating a second fire for the process of carburetting, is in the Lowe apparatus utilized for the gasification of the oil, giving illuminating value to the water gas produced.

I will now describe the Lowe apparatus at Beckton as briefly as possible. This in its improved form is built in three shells placed in a line; respectively the generator, in which non-illuminating water gas is made; the carburetter, in which the oil used for carburetting the water gas is vaporized and partly fixed, and in which the oil gas mixes with the water gas; the mixture of which then passes through the third vessel, the superheater, in which the gas is finally fixed. The shells are lined with fire-clay blocks (the carburetter and superheater are of a diameter of 5 feet inside, and the generator 6 feet 6 inches diameter); an annular space of about 2 inches, packed with asbestos or similar non-conducting material, being left between the outer surface of the blocks and the inside of the shells.

The carburetter and the superheater are filled with checker bricks, about 1½ or 2 inches apart, set in tiers; the bricks in each tier being set at right angles to those in the one immediately below it. The practice sometimes is to set the brickwork in the carburetter, so as to have continuous scores from top to bottom; but the Beckton plant has the carburetters fitted with tiers arranged as the bricks in the superheater are invariably set—viz., with the bricks so placed that the spaces between one tier baffle those of the next tier but one below it, thus thoroughly breaking up the flow of gases passing through the vessels.

The generator is fitted with a feeding-door at the top. Round its circumference immediately below the grate-bars, which are supported on an iron frame, are four clinkering

doors spaced equally round the shell, through which the clinkers are withdrawn and the fire cleaned. Below the grate is riveted an inverted wrought-iron cone, the frustum being fitted with a gas-tight valve, by which, when opened, the ashes escape from the apparatus. The generator is connected near its top with the carburetter by a fire-clay lined cast-iron connection; this in its turn being connected at the bottom with the superheater by a similar connection. At the top of the superheater is the outlet connection, fitted with a stack-valve, by which the waste blast gases escape from the apparatus when "blowing up" (as the process of heating up the fuel and superheating apparatus, preparatory to making gas, is termed). This valve, as are all the other valves required to be handled in making gas, is manipulated from the "working floor," fixed at about 14 feet from the ground floor.

The outlet connection on the superheater is carried downwards into a cylindrical hydraulic seal-box, and forms a jacket for a series of tubes connected by a cast-iron annulus top and bottom, forming an oil-heater in which the gas being generated in the apparatus pre-heats the oil, previous to its entry into the carburetter, which it does by means of a connection with a spray-regulating arrangement fitted in the top cover. On leaving the seal-box, the gas is scrubbed and condensed by suitable apparatus, coupled to a relief gasholder, in the outlet of which is fixed an exhauster, by means of which the gas is forced through the purifiers.

The heating-up of the apparatus to the necessary temperature is effected by an air-blast furnished by a Sturtevant blower, worked by a 20-horse power engine running at about 300 revolutions per minute. The primary air is brought into the generator under the grate-bars by a branch off the main duct; the secondary air entering the top of the carburetter and the bottom of the superheater by similar smaller branches. The admission of air to the different vessels by these branches is controlled in each case by a valve handled from the working floor. A relief-valve is fitted in each of these pipes. The admission of steam under the generator grate-bars is also regulated from the floor; and it may be noted that it is important that the steam should be well spread over the area of the generator fire.

The supply of oil to the apparatus is effected from a measuring-tank by means of a small steam-pump, thence through the oil heater, and so through the spray arrangement into the carburetter.

Having described the general arrangement of the plant, I will now explain the method of working it. At first starting, the generator, being filled with hot coke or with cold coke laid on shavings and lit, is heated, the stack-valve in the superheater being closed, air being drawn through the fuel under natural draught, and escaping by the feeding opening till the generator fire is nicely hot, when the feeding-door can be shut, the stack-valve opened, and a gentle blast of air turned on into the generator, which, afterwards passing through the carburetter and superheater, at first dries them, and afterwards, a fuller blast being put on, brings the top of the carburetter to a dull red. Secondary air is then turned into the carburetter, combusting in it the gases generated by the passage of the primary air through the generator fuel. The same process is repeated with the superheater till the brickwork in both vessels is thoroughly heated up. The heats can be watched through sight-cocks fitted on the shells of each vessel. If a heavy oil is to be worked, it is advisable to have the carburetter at a dull red heat; the superheater being worked by a heat gradually increasing to a cherry red towards its outlet. A light oil can be more violently "cracked up" in the carburetter, which should be worked at a brighter heat for this purpose. As a rule, when dealing with a strange oil, heats should be run dull; and gradually increasing to the brightest heat the particular oil will bear without depositing lampblack on the checker bricks—a most objectionable feature, as this means a cessation of gas making for some time, during which the lampblack has to be burnt out, and then for the apparatus to cool again to a working temperature.

Now, assuming the apparatus to be at its proper temperature, the fuel in the generator filled well up, clean and thoroughly hot, gas making may be commenced. The air blast is shut off the vessels, commencing with the superheater and working back to the generator. Steam at about 120 lbs. pressure is then turned on under the generator fuel, and passing upwards is decomposed into hydrogen and oxygen; the oxygen combining eventually with the fuel to form carbonic oxide with a small percentage of carbonic acid. To give illuminating power to this non-illuminating water gas passing into the carburetter, oil is turned on by a small steam-pump driving it through the oil-heater to the carburetter; the spraying arrangement being set to effect the entry of the oil at about 30 to 40 lbs. pressure, in order to thoroughly disperse it over the area of the heated brickwork. The oil is completely vaporized in the carburetter, and mixed with water gas, the mixture of which, passing on through the superheater, is then thoroughly fixed by the more highly heated brickwork in that vessel. From the superheater the gas passes through the seal to the relief holder, on its way being scrubbed and condensed; and from there through the exhauster into the purifiers. The heats in the carburetting and superheating vessels are readily regulated, and should be worked just under the sooting-point of the oil being used; the deposition on a paper held in a jet of the outlet gas showing this at once. The apparatus is run thus for a period varying from six to nine minutes, when the oil is shut off; steam being kept on for from a minute to two minutes longer, to clear the oil vapour out of the apparatus.

The heats by this time are running low, and the proportion of carbonic acid in the water gas is, in consequence, increasing rapidly; rendering it necessary to terminate the run and to blow up our heats again. Steam is shut off, the stack valve opened, and the air blast put on under the generator, then into the carburetter and superheater respectively. The heat is thus blown up for about the same length of time as was taken by the run, when gas-making will be again carried on. Thus the work goes on—alternate runs and blows only varied by periods at intervals of about four hours for clinking the fire and filling up the generator with fresh fuel. One man on the working floor can readily manipulate a plant working 500,000 cubic feet per day.

The Beckton plant is in two tiers of apparatus built side by side, each set of 500,000 cubic feet per day capacity. This method of erection enables us to have a steady flow of gas being manufactured; one set of apparatus being blown up while the other is making gas, and *vice versâ*.

As to cost of manufacturing gas by this process. Two sets of plant, as above described, can readily be worked by two men on the working floor, besides whom will be required two men engaged in cleaning fires, charging generators, and doing odd work generally, and one man working the engine driving the fan and firing the boiler.

Working eight-hour shifts, 15 men per day will manufacture 1,000,000 cubic feet of gas; and it will be readily understood that having regard to the general attitude of working men of the present day, this is a very important feature in the working of a gas-producing plant. The manufacturing wages per 1000 feet of gas in the purifiers on this basis are 0·98d.

Before dealing any further with the cost of producing carburetted water gas, the writer would draw attention to a few facts connected with the oil carbonized in the apparatus. Various oils have been tested at Beckton—American, Russian, and British; the latter being produced from shale. American gas oil is unfortunately at present beyond the possibility of working here, owing to its low flashing-point. The shale oil tested, besides giving a comparatively low yield of illuminating constituents, evolves in the production of gas a large proportion of sulphuretted hydrogen, and compounds of sulphur other than sulphuretted hydrogen. The Russian oil thus practically becomes a *sine quâ non* with gas-making plant here. It was hoped at first that "Novorrossisk"—a Russian oil of about ·943 specific gravity, having a flashing-point of 165° Fahr.—could be utilized. This oil is equal to about 1040 sperm candles per gallon, and is very cheap; but it contains from 7 to 10 per cent. of free carbon and pitch, so this otherwise excellent oil is rendered impracticable for use with the Beckton apparatus by the pertinacity with which the carburetter and superheater will insist upon being clogged up—in the case of a low heat, by pitch and coke; and in the event of a higher heat, by lampblack. The production of the apparatus, due to constant burning out and subsequent re-cooling, is diminished thus to less than one-half of its normal output.

After trying many oils, the one apparently suiting the apparatus best was found to be a distillate of about ·860

specific gravity with a flashing-point of about 130°·Fahr.; giving an illuminating power of about 1200 candles per gallon. This oil, leaving no residue on being distilled, was found to work admirably; readily burning off, giving a high illuminating power to the gas made, and leaving the checker bricks in the apparatus clean at temperatures varying over a wide range. With this oil an illuminating gas has been made of 29½-candle power, with an expenditure of 4·5 gallons per 1000 cubic feet of gas.

Taking the value of a ton of Lesmahagow as 74,000 candles, and calculating on the basis of the value of the oil just given, an equal result (74,000 candles) will be obtained by the use of 56·4 gallons, worth, at the rate of 3½d. per gallon, 16s. 5½d. The coke used per 1000 feet of carburetted water gas is about 45 lbs. The total cost of 1000 feet of gas of 29½-candle power will thus be, for manufacturing wages and material:—

	s.	d.
Oil, 4½ gallons, at 3½d. per gallon	1	3¾
Coke, 45 lbs., at 12s. 6d. per ton	0	3
Manufacturing wages (including ¼d. for purification)	0	1½
Total	1	8¼

No mention is made of water used in condensing and scrubbing; the tar produced being held to counterbalance this. 25-candle gas would, at the same rates, be made for 1s. 6d. per 1000 cubic feet.

The carbonic acid in the crude gas made at Beckton is kept well down, generally about 4 per cent.—a low figure, using coke in the apparatus.

The writer has done his best, in the short space of time at his disposal, to familiarize his hearers with what he considers to be one of the best types of illuminating water-gas plant yet invented. The study of this gas is a most interesting one; and there can be no doubt it will be forced generally on the gas world in this country before long, by the increased demands for illuminating power which will necessarily come with the spread of the electric light. Of the economical efficiency of illuminating water gas, considered as an enricher of coal gas, there can be no doubt—given in the first place good plant, and secondly a good oil, at a fairly cheap rate, to work in it.

Mr. A. G. Glasgow, M.E., followed with a paper on

CARBURETTED WATER GAS.

The subject of this paper is a broad one; and he is ambitious indeed who does not immediately qualify its announcement by defining his limits of treatment. Upon the present occasion I am content to confine my remarks to the two questions that it is reasonable to infer will most interest British gas engineers—viz. (1) Under what conditions is the manufacture of carburetted water gas in this country advisable? (2) Supposing such conditions exist, what are the principal features regulating the successful design and operation of a carburetted water gas setting? As the former question is mainly one of shillings and pence—although other considerations, hereafter named, may largely influence it—I propose to give first and fully the working results usually obtained in water-gas manufacture, from which a comparison can be readily drawn between the cost of water gas at any given point, and its equivalent under the prevailing system of manufacture. The following results are usually obtainable with a well-designed water-gas setting, making gas of from 24 to 30 candle power.

Generator Fuel.—Where the apparatus is in comparatively constant operation, the gross consumption of fuel in the generator should not exceed 32 lbs. of good gas coke per 1000 cubic feet of purified gas. Where the apparatus is in use about half the time, 35 lbs. should not be exceeded. If its use averages five or six hours a day, 40 lbs. of coke will be required. Where the capacity of the apparatus is small—less (say) than 200,000 cubic feet per 24 hours—these figures are usually, although not always, overrun. It should be noted that screenings are recovered from the generator ash to the extent of about 5 lbs. per 1000 cubic feet of gas. These can be burned under the boiler or returned to the generator fire; thereby correspondingly lessening the gross consumption of generator fuel quoted above.

Boiler Fuel.—A fair average of the quantity of fuel consumed under boilers, when the daily capacity of plant approaches 500,000 cubic feet, is 8 lbs. of coke per 1000 cubic feet of gas made. Coke, however, is seldom used for this purpose; a cheaper substitute, in the shape of breeze, coal dust, or screenings from the generator, being usually employed. When a better disposition cannot be made of the oil tar, it can be burned to great advantage under the boilers. I shall refer to this again under the head of "Oil Tar."

Oil.—This is the crucial feature governing the economic manufacture of carburetted water gas. Its abundance and cheapness account for the wonderful recent development of water gas in the United States. Does its expense inhibit a corresponding development in this country? Parliamentary restrictions forbid the storeage of oils with flashing-points below 73° Fahr.; so we may drop American crude oils and light distillates from our consideration. It may be well, however, to note that such oils will, when properly treated, enrich water gas in the proportion of 7 candles to the gallon, while each gallon yields in bulk about 83 cubic feet of oil gas—that is to say, 28-candle power carburetted water gas, in the proportion of 667 cubic feet of "blue" gas to 333 cubic feet of oil gas, can be obtained with 4 English gallons of such oils.* I have had a recent opportunity of trying several Russian distillates, the flashing-points of which exceed the statutory limit, with gratifying results. Some of them—notably one known as "solar distillate"—quite equalled the American oils mentioned above. The cost of this oil, I am told, is 3¼d. per gallon; making the total cost of the oil 11½d. per 1000 cubic feet of 24-candle power gas.

Labour.—The labour required depends largely upon the capacity of plant and size of the individual machines. Taking, as a basis for this and the succeeding estimates, a plant of 1,000,000 cubic feet capacity, composed of two 500,000 cubic feet machines, the generating labour per shift may be classed as follows: 1 foreman for boilers, 2 gas makers, and 2 helpers—total, 5. With eight-hour shifts, at 4s. 6d. per man, this would be 0·8d., and with twelve-hour shifts 0·54d. per 1000 cubic feet. With a 2,000,000 cubic feet plant, composed of two 1,000,000 feet sets and a simple mechanical system for handling the coke, the same number of men would suffice; making the total generating labour 0·4d. and 0·27d. respectively for eight and twelve hour shifts.

Purification.—The expense of purification varies with the oil and coke, but is practically the same as with coal gas. The ammonia present is inconsiderable.

Water.—The total consumption of water, covering all purposes, is usually about 50 gallons per 1000 cubic feet. The bulk of this water is circulated continuously; the oil tar separating by gravity.

Repairs and Maintenance.—The item of repairs to generating plant is extremely small. It should not exceed ¼d. per 1000 cubic feet. In well-built American water-gas works, ¼d. will cover all repairs to manufacturing plant, including gasholders; and it is seldom that the charge reaches this figure.

Superintendence.—This item will never exceed ½d. per 1000 cubic feet, and will rapidly grow less as the make increases.

Oil Tar, a Residual.—Where Lima crude oil (the usual and cheapest American carburetting agent) is used, oil tar is recovered to the extent of 15 per cent. of the total quantity of oil consumed. It is true that this tar contains in fixed suspension at ordinary temperatures, about 25 per cent. of water; but, as it is marketed or used in this form, without further treatment, this feature need not be here considered. Since, when burned under the boilers with a small quantity of the cheapest solid fuel, this tar is sufficient to generate the steam required, and moreover enables the fireman, while maintaining a uniform steam pressure, to give practically his whole time to other duties (such as clinkering and coaling the generators), it makes a most satisfactory boiler fuel. Of late years, however, it has been generally recognized by the American market as too valuable a product for such service, and is now turned over to chemical works and tar distillers at a price invariably in excess of the cost of an equal quantity of the original oil, and in some localities at double this cost. I have no knowledge of what the return from this source will be in this country; but it will certainly equal the cost of the water used. Both of these items, therefore, are struck out of the following estimate.

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* The author explained that the English gallon is about 20 per cent. more than the American one.

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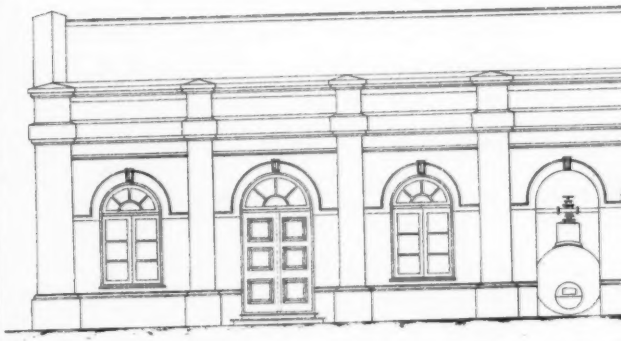

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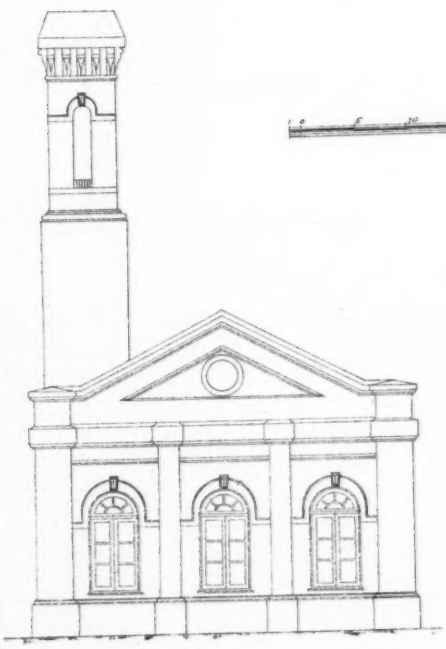

— END VIEW OF EXHAUSTER ROOM —

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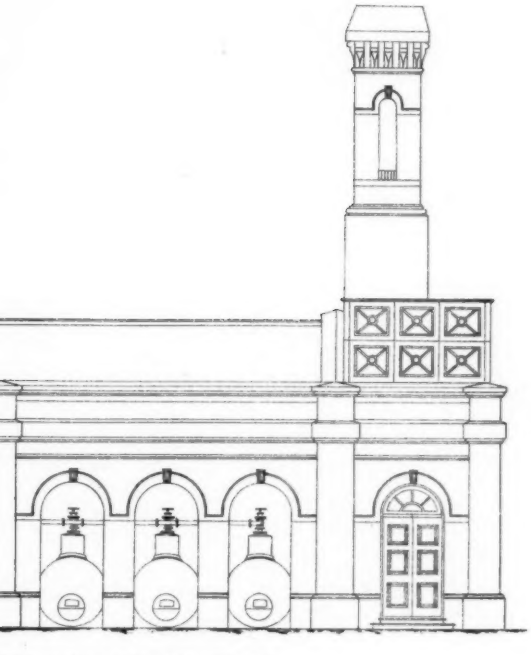

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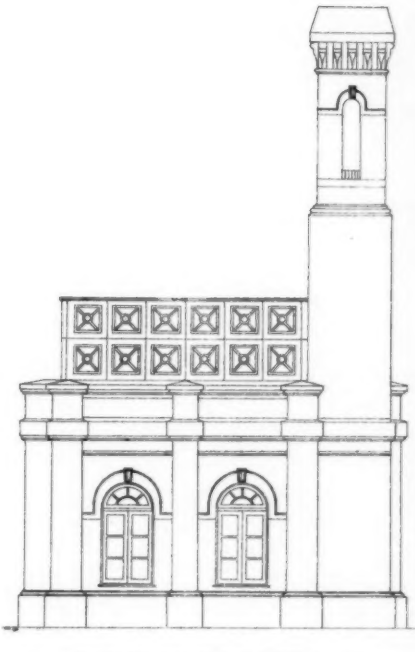
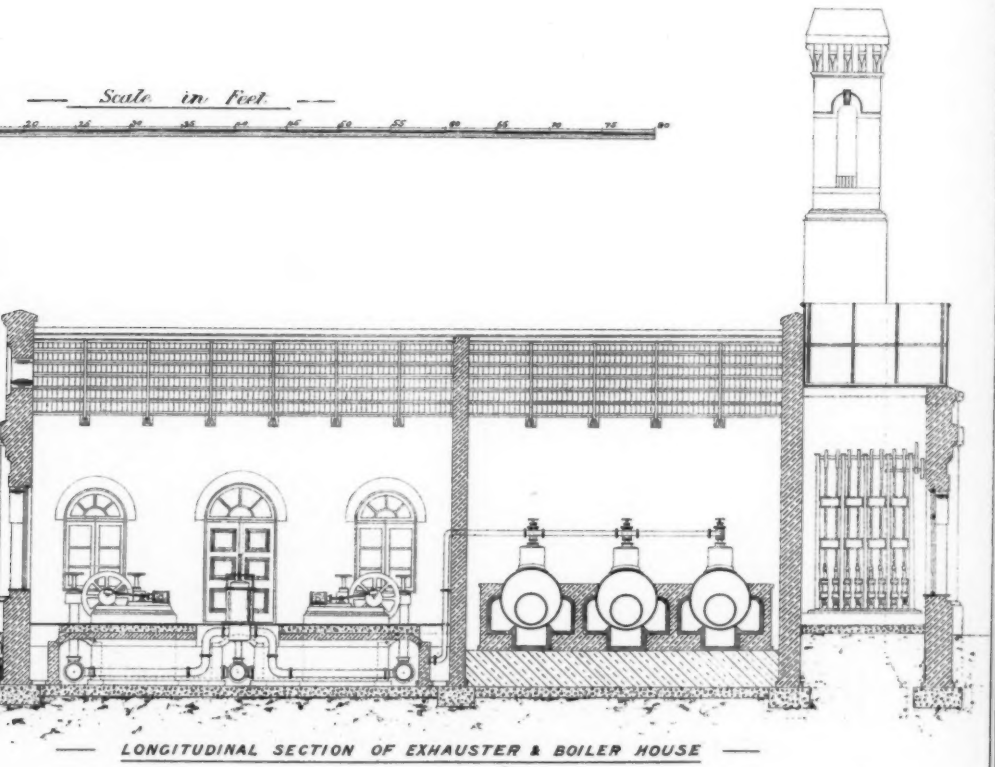


END VIEW OF PUMP ROOM

Scale in Feet.



LONGITUDINAL SECTION OF EXHAUSTER & BOILER HOUSE

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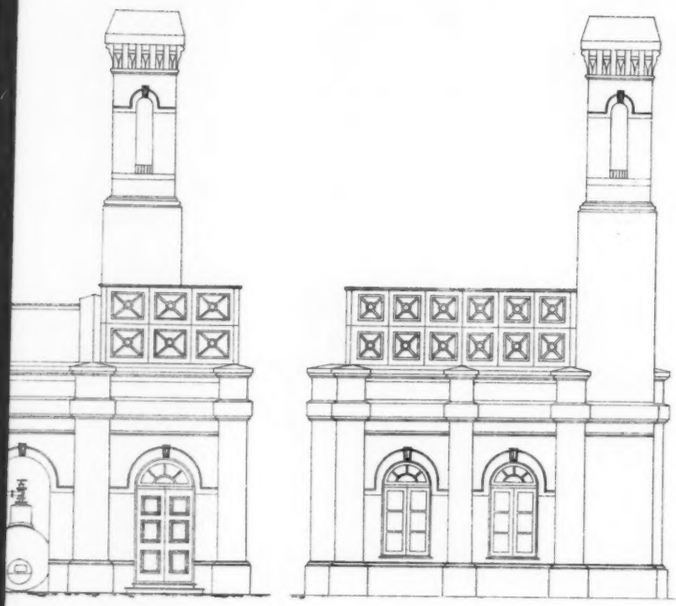
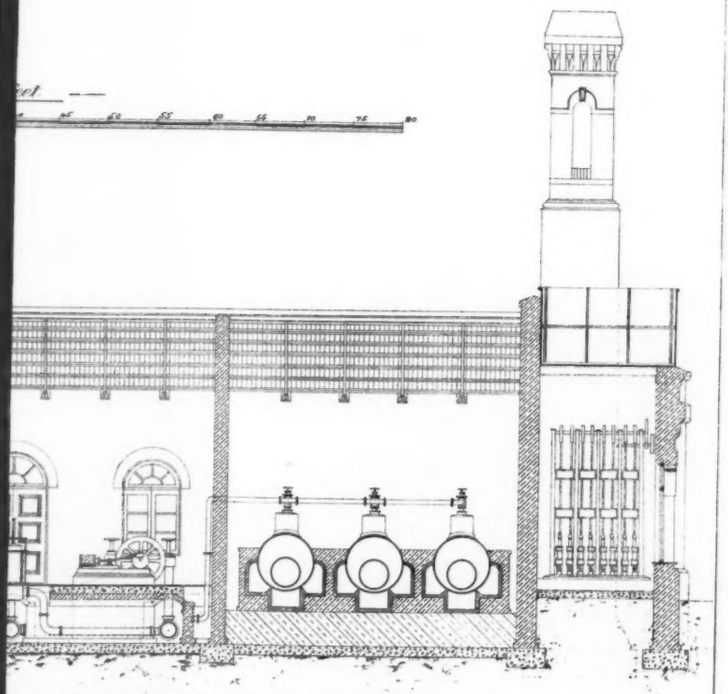


...USE — — END VIEW OF PUMP ROOM —

— FRONT ELEVATION OF SULPHATE FACTORY —



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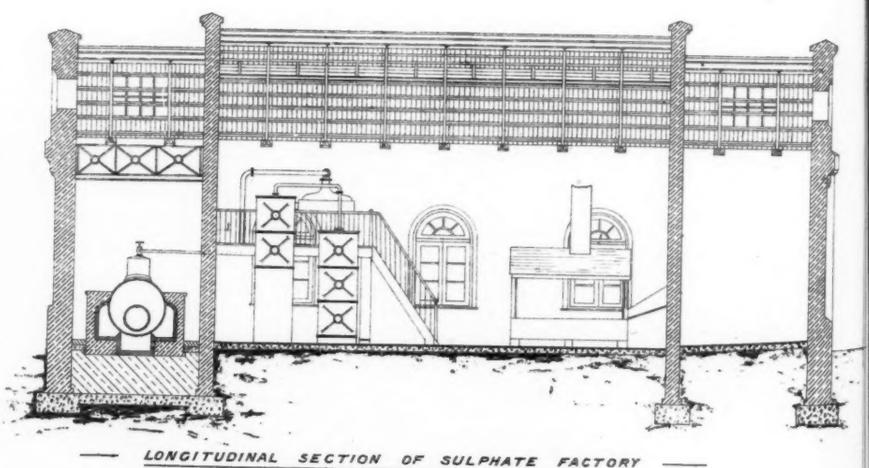
— Scale in Feet —



— LONGITUDINAL SECTION OF SULPHATE FACTORY —

C.E. STEVENSON, Engineer.

Total Cost, in the Holder, of 1000 Cubic Feet of 24-Candle Power Water Gas.

	s.	d.
40 lbs. of coke, at 15s. per ton	0	3½
Oil, as previously quoted	0	11½
Labour, total employed	0	1½
Purification material	0	0½
Repairs and maintenance	0	0½
Superintendence	0	0½
Total	1	6

This figure contemplates the independent operations of a water-gas plant without connection with coal-gas manufacture. By a judicious combination of the two systems, so that coke hot from the retorts can be fed directly into generators, while the furnace clinkerers can look after generator fires, a material saving can be effected.

Regarding water gas as an enriching agent, we have simply to compare the above price with the cost of cannel gas of equal luminosity. If the figures are equal, the balance of favour rests decidedly with water gas, for the following reasons: The greatly reduced ground space required; the large difference in the first cost of plant; the ability to change the candle power at will and instantly; the ability to increase the make to the full capacity of plant at three hours' notice, and without injury to the apparatus (half this time suffices where hot coke is available); the ability to shut down the plant instantly without loss of gas, and to keep it idle for a number of hours without appreciable loss in economy; freedom from the depreciating influence of cannel upon the coke; and the reduced output of coke, and consequent probability of an increase in the price of that commodity.

So much for water gas as an enricher. Now let us see what chance it will have as a recognized system of manufacture; let us compare it for a moment with standard coal gas of 16-candle power.

Gas of 24-candle power at 1s. 6d. per 1000 cubic feet is the exact equivalent in luminosity of 16-candle gas at 1s. The consumer, let us suppose, pays 2s. 6d. for his 16-candle gas, costing 1s. in the holder. He can, therefore, afford to pay at the rate of 3s. 9d. for a 24-candle gas. By an expenditure of 6d. at the works, the consumer is benefited 1s. 3d.; or, in other words, the gas company makes an additional profit of 9d. per 1000 cubic feet on the gas sold—the position of the consumer remains unchanged. In spite of the consequent reduction of 33 per cent. in the output, the advantage lies with the richer gas, unless the net profit from the coal gas exceeds 1s. 6d. per 1000 cubic feet.

I am well aware of the weakness of the foregoing line of reasoning. In the first place, no attention has been paid to gas used for other than illuminating purposes. Also, the consumer is regarded as willing to entrust his welfare to the hands of the local gas company—an attitude absurdly foreign to his nature all the world over. But the argument seems sufficiently stable to justify me in presenting it as an indication that there may be a wider field for the manufacture of water gas in this country than the mere displacing of cannel can afford; and, in my opinion, this opening becomes positive and assured when we have a system of retorts and water-gas apparatus so intimately combined that the whole of the coal is converted into gas, with an absolute minimum of labour, space, and cost of plant. Such an apparatus, of approved design, is about to be placed upon the market.

Let us now pass to the second and last question for consideration—viz., what are the principal features regulating the successful design and operation of a carburetted water-gas setting? The design and operation are mutually dependent, and may be treated of together, as follows: Keep the generator fire in a uniformly hot and healthy condition, varying as little as possible from the best temperature for gas production. This necessitates short "runs" and "blows;" their lengths being determined experimentally. The generator fire must be sufficiently deep to ensure proper decomposition of the steam when the apparatus is working to capacity. Never admit an excess of steam; always admit a sufficiency of steam. So adjust the blasts that the generator and superheater will reach their proper respective heats simultaneously, while all the carbonic oxide produced is being consumed in the superheater with no excess of air. This necessitates the proper relation between the cross section and the depth of the generator fire—a most important factor.

The correct proportion of superheating space depends somewhat upon the oil to be used; but it may be laid down as a general rule that all oils do better when gasified by a prolonged exposure to a moderate heat than when brought into briefer contact with a highly-heated medium. Furthermore, the larger the superheater, the less the variation from proper temperature during a "run," and therefore the decreased production of tar. It may be noted here that the heats should never be carried sufficiently high to produce lampblack; it being always preferable to incline rather to the production of tar, which is a useful residual, and creates no nuisance from stoppages. The features limiting the size of the superheater are: The loss of the gas contained therein at the end of each run; the increased loss from radiation and air convection; the difficulty in maintaining properly distributed heats; the increased time required in bringing into action a cold apparatus; and the limit to the beneficial influence of the heat upon the oil vapours. These points have been practically and carefully determined for American oils; and there is no reason why the same general proportions should not hold good in England.

It is essential that the heavier oils should be pre-heated to a considerable degree before their introduction to the apparatus; the most successful treatment requiring that the oil should be raised from atmospheric to the final temperature of issue from the superheater by gradual and gentle increments of heat.

Mr. W. Foulis (Glasgow) read the last of the three papers, which was entitled—

SOME NOTES ON THE USE OF OIL AS A SUBSTITUTE FOR CANNEL.

The object of this communication is not to describe any new process of manufacture, nor to communicate information not generally known; but to afford the members an opportunity of discussing the question whether or not oil can be advantageously substituted for cannel in enriching coal gas. The subject is not new. In 1868 the late Mr. T. G. Barlow, in his address as President of the British Association of Gas Managers, referring to the progress in gas manufacture during that year, made the following remarks: "The advance in the price of cannel, consequent on the increased consumption, has stimulated inquiry to find a substitute for it." After referring to a method then recently introduced of using oil as an enricher, and also to the use of natural bitumen, he further said: "These applications of shale oil and bituminous substances, more especially shale oil, afford reason to believe that the threatened difficulty arising from the scarcity of cannel may in some measure, if not entirely, be overcome." If a substitute for cannel was a desideratum at that time, it is much more so now. Not only has the demand greatly increased, but several of the sources of supply have become exhausted, while no new fields have been discovered; and the difficulty of obtaining first-class cannel is being felt more or less over the whole country. A discussion, therefore, by the members of the Institution, on the best means of obtaining a substitute for it is highly desirable.

The manufacture of gas from oil is about as old as the manufacture of gas from coal. The process of manufacture is to pass the vapour of oil over a red-hot surface; the hydrocarbons are thereby "cracked" or broken up, producing permanent gas, a deposit of carbon, and usually a thickish black tar. At the present time there is probably not less than 40 million cubic feet of oil gas annually made in this country; and in America, as is well known, oil is largely used in the manufacture of gas, not only for carburetting water gas, but also for enriching coal gas. The process, therefore, is not new, nor are we without experience in its use; and the questions to be considered are the best method of using oil, and the commercial advantage to be derived from its employment.

The method of using oil for enriching gas referred to in the above quotation was known as Mackenzie's process. This process was in operation for some time in Dublin, and consisted in grinding coal with shale oil in certain proportions, and charging in the usual way. In 1873 the author made a number of experiments with this process. The record of these experiments has unfortunately been mislaid; but, generally, the results were as follows: With about 20 gallons of oil to a ton of common coal, 9800 cubic feet of 25-candle gas were obtained. Experience

showed that the best mode of using the oil was to grind it with a portion of the coal only, and to mix this with the remainder just before charging. The results were, however, uncertain. It was impossible by this method to ensure that all the oil was exposed to the same amount of retort surface. That which lay near the front of the retort was under-exposed; while the oil at the back of the retort was subjected to too great a decarbonization. The opinion come to at the time the experiments were made was that, to ensure success, it was essential that some other method of manufacture should be adopted by which the results would be more under control.

The different kinds of apparatus now used in the manufacture of oil gas are all very simple. In Pintsch's apparatus the retort is divided into an upper and a lower compartment. In the upper compartment there is placed a shallow vessel or tray, into which the oil is run. It is there vaporized; and the vapour passing through the lower compartment is decomposed, and permanent gas formed. In Keith's apparatus, as well as in several others, there is no division in the retort; but the oil is run directly into it at one end, and there vaporized. The vapours passing through the retort to the opposite end, permanent gas is formed.

From experiments made by Dr. Stevenson Macadam, recorded in a paper published in the Transactions of The Gas Institute for 1887,* and by Mr. Ivison Macadam, recorded in a paper published in the *Journal of the Society of Chemical Industry* for March, 1887,† there does not seem to be much difference in the results obtained by either of these methods. With through retorts it is probable that good results might be produced by running the oil into a flat dish or tray placed at one end, and allowing the vapours to pass to the opposite end; the ascension-pipe nearest the tray being plugged. One advantage of this arrangement would be that the retorts could be adapted for either coal or oil at pleasure.

In 1887 the author received from Mr. Greenhough, of Boston, a sketch of the apparatus used by him in making gas from oil or naphtha in ordinary coal retorts; and with this apparatus a number of experiments were made, extending over several months. It consisted of a pipe 1 inch in diameter, screwed into the retort-lid, and reaching nearly to the back of the retort. This pipe was enclosed in another 2½ inches in diameter, sealed at the inner end, and this again by a pipe 4 inches in diameter, closed at the mouthpiece end. The oil was injected into the inner tube by a small jet of steam; the principal object of using steam being to keep the pipe clear. Care was taken not to use too much steam, which would have impaired the quality of the gas. The oil was vaporized at the inner end of the middle tube, and the vapour going through the length of that tube towards the mouthpiece end, and then through the outer tube towards the back of the retort, was heated to a considerable degree before coming into contact with the red-hot surface of the retort, passing over which it was decomposed, and permanent gas formed. These pipes were laid with an inclination towards the back of the retort, and were easily removed, so that the retort could be used for either oil or coal. The retort was 18 in. by 13 in. by 9 ft. long; and when working most advantageously, it was capable of carbonizing about 4 gallons of oil per hour; the make per retort being about 7500 cubic feet in 24 hours. The oils used were mostly what are known as intermediate shale oils, having a specific gravity of ·846 to ·850. These oils were at that time a drug in the market; and even now they may be purchased at a comparatively low price. It is from this grade of oil that nearly all the oil gas is made in this country.

It is sometimes asked, "Why not use the shales for gas making in the ordinary way?" But the shales from which these oils are derived are almost worthless for gas manufacture; yielding only from 6000 to 8000 cubic feet per ton; the refuse (it cannot be called coke) is quite worthless, containing 50 per cent. and upwards of ash. They can only be profitably used in gas-works in the vicinity of the pits, and where the cost of carriage is small. Our experience in using these shales is that the gas wants permanency; and the quality suffers severely in the cold weather. There are shales which give much better results, and differ from cannel only in the amount of ash they contain; but these are too expensive for oil making, for which purpose they are not so suitable. In the experiments above referred to, it was found that the best retort temperature was a bright red. At this temperature, and when using about 4 gallons of oil per hour, the yield of gas was from 75 to 80 cubic feet per gallon, the illuminating power being from 66 to 62 candles. With higher heats and a slower rate of oil supply the volume of gas was largely increased. In some experiments, as much as 150 cubic feet of gas was obtained from a gallon, equal to 39,700 cubic feet per ton of oil; but the illuminating power fell to 28 candles. At these high heats it was found impossible to continue working the apparatus for any length of time, as the pipes from the hydraulic main to the condenser became blocked up with carbon. When the oil was run in at a greater rate than from 4 to 5 gallons per hour, the temperature of the retort was speedily reduced, and a large proportion of the oil passed through the retort unaltered, and was condensed in the apparatus. The proper rate of oil supply could, after some experience, be determined by the colour of the smoke or gas issuing from a stop-cock fixed in the ascension-pipe, close to the mouthpiece.

In the papers above referred to, the yield per gallon is given at from 90 to 100 cubic feet; but these experiments were made on a smaller scale, and probably with more carefully selected oils. From a table given as an appendix to a paper in Vol. XCIII. of the Transactions of the Institution of Civil Engineers, it appears that the average make per gallon of oil in the gas-works belonging to the different railway companies is 76·6 cubic feet. Therefore 80 cubic feet of 62-candle gas, equivalent in illuminating value to 17 lbs. of sperm, or to 1000 cubic feet of 4·66-candle gas, may be safely taken as the amount which can be obtained in practical working from oils of this quality. This is also corroborated by experience in carburetting water gas, which entirely depends for its illuminating power on the quantity of oil gas it contains.

In a paper on "Water Gas" written by Mr. A. C. Humphreys, of Philadelphia, for the Mechanical Science Section of the British Association for the Advancement of Science in 1889,* it is stated that 4¾ gallons of oil are required to make 1000 cubic feet of 24-candle gas. Professor Vivian B. Lewes, in his lectures on "Gaseous Illuminants," published in the *Journal of the Society of Arts*,† states that it requires a gallon of Russian oil per 1000 cubic feet for every 5½ candles; and from statements published in American papers, it appears to require about 4·5 gallons of oil per 1000 cubic feet to get an illuminating power of 22 candles. This is equivalent to 17 lbs. of sperm per gallon; and for the purpose of enriching coal gas, it is difficult to see what advantage is to be gained by using carburetted water gas instead of oil gas. To take a practical illustration: To raise 16-candle gas to 17·5 candles, it requires 25 per cent. of 22-candle gas—that is to say, 750 feet of 16-candle gas and 250 feet of 22-candle gas will give 1000 cubic feet of 17·5-candle gas; and to make this quantity and quality of carburetted water gas, it is necessary to use rather more than a gallon of oil. But 968 cubic feet of 16-candle gas and 32 cubic feet of 62-candle gas will also give 1000 cubic feet of 17·5-candle gas, requiring only 0·4 gallon of oil. There are oils or naphthas which yield much higher results than those above referred to; but these have generally a much lower flashing-point, and are therefore not so safe; they cost more; and, the supply being less plentiful, they are more likely to be affected in price by an increased demand. Mr. Ivison Macadam, in the paper published in the *Journal of the Society of Chemical Industry* already referred to, gives some useful information as to the yield of gas from various descriptions of oil. From crude shale oil he obtained 98·7 cubic feet of 50·3-candle gas, and from American petroleum 86 cubic feet of 66-candle gas. In practice on a large scale, these results might not be obtained; but they are useful as indicating the comparative qualities.

The crude oils are difficult to deal with in the ordinary apparatus, in consequence of their viscosity. A method of using oil, which seems in some favour in America, appears well adapted for dealing with thick oils. A tube, 4 inches in diameter and 5 feet long, closed at one end, is filled with breeze, a sufficient quantity of oil is poured in

* See JOURNAL, Vol. L., p. 110.
† Also noticed in the JOURNAL, Vol. XLIX., p. 856.

* See JOURNAL, Vol. LIV., p. 644.
† Also in the JOURNAL, Vol. LVI., pp. 1140, 1194, 1240, 1288, 1334.

to saturate the breeze, the pipe is placed in a retort with the open end inwards, the oil is gradually vaporized, and the vapour passing through the length of the retort, permanent gas is formed. A number of experiments recently carried out with this appliance gave very satisfactory results. They were made in a small retort; and the tube was 3 inches in diameter. Russian oils were used; and a yield was obtained equal to a sperm value of from 18 to 18·75 lbs. per gallon—the best results so far obtained being 89·14 cubic feet of 61·36-candle gas per gallon.

While the existing retorts may be adapted for making oil gas, it will probably be found most advantageous, in manufacturing this gas on a large scale, to erect special benches for treating the oil, in which a large heating surface could be obtained in a small space. Probably the best arrangement would be a series of horizontal flues—a heat flue and an oil-gas flue alternately—the apparatus being heated by producer gas. The oil gas should be mixed with the coal gas, either in the hydraulic main or as soon thereafter as possible.

Although the process of making gas from oil is simple, there are so many inconveniences attending the storing and manipulating of large quantities of oil in gas-works, especially when these are situated in crowded districts, that unless considerable economy was to be obtained from its use, and a reasonable certainty that the supply is sufficient to meet the demand without raising the price to an extent which would make its use unprofitable, there would be little or no inducement to adopt it. Assuming the quantity of gas of 62-candle power which may be obtained from a gallon of oil to be 80 cubic feet, then, as there are 265 gallons in a ton, we find that a ton of oil will yield 21,200 cubic feet, equivalent to 4506 lbs. of sperm. Oil capable of giving the above results may at present be purchased at about 3d. per gallon, or (say) £3 6s. 3d. per ton. Comparing this with the value of a ton of high class cannel—say, of a quality equal to the well-known Lesmahagow, from which 13,000 cubic feet of 31·5-candle gas may be obtained, equivalent to 1404 lbs. of sperm—w efind that the relative value of a ton of such cannel for enriching ordinary coal gas is 22s. 8d. To the cost of oil has to be added the cost of fuel for carbonizing; and to the comparative value of the cannel, the amount which would be obtained for residual products, less the increased cost of labour in carbonizing. These items will vary at different places. But assuming the value of the fuel to be 3s., and the residuals, less labour, to be 4s. 6d., on calculating we find that, for the purpose of enriching ordinary coal gas, a ton of oil at £3 6s. 3d. is equivalent to a ton of Lesmahagow cannel at 27s. 2d.; and where cannel rises above this price, it would appear to be more profitable to use oil. These values are based on the quality of the gas it is desired to enrich being 16 candles, and costing at the purifiers 1s. per 1000 cubic feet. If the cost is less than this, the comparative value of the cannel is reduced. If, for example the cost is 9d., the comparative value of the cannel is 25s.; and the use of oil becomes more profitable. On the other hand, if the cost is above 1s., the comparative value of the cannel is increased. There are cannels that are relatively cheaper than those of the higher class; but the equivalent value to a ton of oil may be easily calculated.

The effect of a largely increased demand on the price of oils cannot be calculated with certainty; but a knowledge of the amount of oil manufactured and imported may help us to form an opinion. The quantity of crude shale oil made yearly in Scotland is about 170,000 tons; and that of intermediate oils suitable for gas-making purposes does not probably exceed 20,000 tons, equivalent to about 70,000 tons of cannel. These quantities cannot be easily increased. If dependence were to be placed on these oils alone, the price would certainly rise very speedily on an extended demand. The quantity of oil imported annually is now about 100,000,000 gallons—say, in round numbers, 400,000 tons. The increase on the imports during the last five years has been about 42 per cent.; and from the seemingly inexhaustible supply, there is reason to believe that the quantity could be largely increased without any great advance in price. There are also large quantities of oil now obtained from blast-furnaces and coke-ovens; but until more experience is gained of the gas-producing properties of these oils, we cannot well calculate what assistance could be obtained from this source.

The discussion of the foregoing papers occupied the meeting till the midday adjournment. In the afternoon, the two papers remaining on the *agenda*—one by Mr. Charles Hunt, of Birmingham, on "Purification," and the other by Mr. Alfred Colson, of Leicester, on "The Leicester Gas-Works Extensions"—were read and discussed; and this brought the technical business to a close. These papers, with the report of the remarks made thereon, will appear next week; also the report of the discussion on the three papers given above, which is in type, but has to be held over owing to the demands upon our space.

Votes of Thanks.

The President said that it only remained to pass a few formal resolutions to conclude the business of the meeting. First, he begged to propose a hearty vote of thanks to the Institution of Civil Engineers and their Secretary (Mr. J. Forest), for the facilities they had afforded for conducting the meetings by placing at their disposal the room wherein they were assembled.

Mr. William King seconded the motion, which was carried unanimously.

The President next proposed a vote of thanks to the Auditors (Messrs Magnus Ohren and Alfred Lass) for their services.

Mr. T. May seconded the proposition, which was carried unanimously.

Mr. R. O. Paterson (Cheltenham) proposed a vote of thanks to the Council of the Institution; saying he was quite sure the motion would be received, at the conclusion of a most successful inaugural meeting, with the utmost heartiness. The good offices of the Council during the whole of the initiatory stages of the Institution had resulted in bringing about such a satisfactory gathering as would, he was sure, rouse the hopes and aspirations of every member.

Mr. E. Baker (Reading) seconded the motion, which was carried unanimously; and it was briefly acknowledged by the President.

The President then proposed a vote of thanks to the Honorary Secretary, or rather Secretaries, for they could not lose sight of the fact that, in the inception of the Institution they had the services of Mr. Alfred Colson, who carried it on for a considerable time. Then they had a paid Secretary, who suddenly gave up the work at almost a moment's notice; handing over his papers to Mr. Chapman, who took charge on the spot, and had carried on the work successfully up to the present time. Their best thanks were due to these two gentlemen for the able way in which they had discharged the duties of the office; and he might mention that the Council so much appreciated their services, that a small Sub-Committee had been appointed with a view to presenting them with some appropriate testimonial.

Mr. Hunt expressed his pleasure in seconding the proposal, which was carried unanimously.

Mr. Colson said he appreciated very highly indeed the way in which he had been referred to. From the very first he took the deepest interest in the formation of the society, and did what he could to assist in getting it firmly established. At the same time he could not help feeling that whatever success had been achieved was due to the Council or Committee; and he was sorry to hear that any testimonial had been thought of. He fully appreciated the kindness of his friends; but he should be very glad to know that such a proposition as that which had been referred to was dropped.

Mr. Chapman also acknowledged the vote of thanks, and agreed with what had been already said by Mr. Colson. The success of the meeting which had just been brought to a termination was an ample reward for any small services he had been able to render.

Mr. Foulis then proposed a hearty vote of thanks to the President, to whom, he said, was due a great deal of the success of the meeting. Not only had he given them one of the most admirable and practical addresses ever read before an association of gas engineers, but his whole conduct in the chair had added very much to the harmony and success of the meeting.

Mr. C. C. Carpenter seconded the motion, which was carried unanimously.

The President having briefly responded, the proceedings terminated.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 976.)

THE past week has been one of the gloomiest that has been seen in the Stock Exchange for a long time; and, closing as it did without a sign of brightening, it is to be feared that the Whitsuntide vacation will scarcely prove a period of enjoyment to many members. Foreign affairs have again been at the bottom of the mischief; and the bankruptcy (not to put too fine a point upon it) of Portugal, coming upon the Argentine difficulties, has been a severe blow. On either side of the Atlantic, Iberian finance seems equally unsound. The rise in the Bank rate to 5 per cent. on Thursday was a complete surprise to most people; and it caused them considerable apprehension, fearing that the Directors knew the state of affairs to be shakier than the outside world was aware of. The Gas Market, however, has borne the stress very quietly and with undiminished firmness, as it should. In fact, it is in times like these, when the weakness of so many securities is being exposed, that one should hold on all the harder to good sound trading concerns of this class. Transactions have been decidedly limited, and not a single quotation has moved either up or down; the only changes marked being *ex div.* corrections. Gaslight "A" has been moderately dealt in, at prices varying from 241 to 244; the last transaction being at 242. The debenture, preference, and limited issues have been more than proportionately busy; and good prices were realized for them almost every day. A fair amount was done in South Metropolitans in the earlier part of the week; but later on they were quite neglected. Prices were about an average. Nothing at all was done in Commercials. The Suburban and Provincial Companies have remained quite unnoticed. Among Foreign undertakings, the three Continental Companies were almost alone to make any sign; but what little was done in them was marked at very good figures. The only other business was done in Buenos Ayres debentures, which were perhaps a shade firmer. In Water there has been more business than usual transacted; and the issues of all Companies in general seem fairly firm. The only change in quotation is an improvement of 5 in the buying price of Kent.

The operations have been every day throughout at such a dead level of uniformity (the prices one day being pretty well exactly the same as the day before, and no one quotation having moved either up or down), that a detailed review of the business transacted daily would be a mere repetition. The sole variation in Water—a rise in Kent—was effected on Wednesday.

ELECTRIC LIGHTING MEMORANDA.

The Electric Light Problem in Glasgow—Unlicensed Suppliers of Electric Light—The Affairs of Two London Electric Lighting Companies.

GLASGOW, in common with other places, has its electric light question, which has been put to the usual professional dealers in this class of conundrums. There is a strong family likeness among the municipal dabblers in this matter of electric lighting. First, there is much inquiry and discussion upon the moot point whether the municipality shall or shall not undertake to obtain an Electric Lighting Order. Then, the Order obtained, there is the even more vexing question of what is to be done with it. Usually, for the first year nothing at all is done; the municipality being as timid in regard to their unaccustomed powers as a boy with a cheap pistol which he is proud to possess but afraid to fire. This state of things is not allowed to be prolonged, for there is always some local "House-to-House" or other *soi-disant* electric lighting company to stir up the local authority to do something. So at length, with much creaking and groaning, the municipal machine gets to work, to see what can be made out of the new-fangled electric lighting facilities which have cost so much and seem to be worth so little. The Glasgow Corporation, as might have been expected, have been wonderfully cautious in their handling of this thorny matter. The Gas Committee have had the business in hand; and they appointed a Special Sub-Committee to look into it. This Sub-Committee invited tenders for leasing the privileges of the Order; and they received several offers, which they proceeded to consider in the light of what could be gathered as to the experience of Leeds and Bradford. The result was to indicate that the Corporation had better carry out their Order themselves; and several experts were consulted as to how this should be done. In the event the Sub-Committee favoured a low-tension direct-supply scheme proposed by Mr. Crompton, which would cost £57,307 for an installation of 11,000 16-candle power lamps. This recommendation, or something like it, will come before the City Council in due course.

In the meantime, the Glasgow municipal electric lighting scheme is placed under a cloud by the self-seeking action of a local firm, who have the temerity to supply as much electric light as is wanted for the central parts of the city by an overhead-wire, high-pressure system, without any Provisional Order or other sanction except the business demand and the way-leave of the owners of the property over which their wires run. Whether or not this speculation pays, there it is; and it runs the municipal scheme hard for public favour. There is nothing absolutely illegal in overhead wires, and the owners in this instance have been careful to comply with the Board of Trade requirements in every respect; so that nobody can touch them. It is consequently seen to be a poor look-out for the Corporation, who will be bound to supply, if at all, by a costly underground system of distribution, which will be underbid at every point by this unauthorized firm. So long as the speculating firm continue to conform to the requirements of the Board of Trade, there will be nothing to hinder them from running all over Glasgow, and taking the cream of the trade. This is a serious consideration for any local authority contemplating sinking public money in providing electric lighting plant; for, after this rate, their Provisional Order is absolutely valueless. The Glasgow Gas Committee are evidently at their wits' end to know how to deal with these speculators, who have so hopelessly spoilt the local market for electric lighting.

The ordinary annual general meeting of the Chelsea Electricity Supply Company has been held. The circumstances of this Company are specially interesting to observers of the development of the electric lighting business, because they are almost the oldest-established undertaking of the kind in London, and have a capital residential district. They are not, of course, so well off in the latter respect as the St. James's Company; but then this Company is exceptionally situated. Of the Chelsea Company it may be said that they have as good a lighting district as can be found in England; and if they cannot make money where they are, they could not possibly better themselves. This being so, what are the facts? The Directors report a gross profit on last year's working of £543, out of a total revenue of £6067. More capital is to be spent upon the extension of mains, which, one would have thought, might have been delayed until those already laid had begun to pay better. However it is to be supposed that the Directors know their own business best. The new capital issue is to be in the form of 6 per cent. preference shares; and when this is spent, there will be about £92,000 laid out upon an establishment of 36,000 8-candle power lamps. From these lamps it is calculated that an average rental of 9s. per annum will be received, which would represent a gross income of £16,000 per annum. There is no knowing how much of this revenue will be required for working expenses; but at least half of it may be supposed to go that way, without allowing for depreciation. After this way of reckoning, the prospects of the Chelsea Electric Company appear to be anything but rosy. Nor is a gloomy outlook their peculiar portion. The Kensington and Knightsbridge Company have as fine a district as could be desired, yet they are practically in the same straits, having to spend money upon extensions of mains—which means running after custom—before those already in position are paying for themselves. Here again the official apology for the actual state of affairs takes the form of a calculation that *if* they had 40,000 lamps out, at an average rental of 10s. each, there would be an income of £20,000 a year, out of which there should surely be enough to pay interest on debentures, preference dividends, and leave something over for the ordinary shareholders! The plea is anything but a strong one; yet it is the best that can be offered. Mr. R. E. Crompton, however, rather "let the cat out of the bag" at the Knightsbridge meeting, by confessing that "there had been a hanging back on the part of consumers at the beginning of the year; but they were now going on at a better rate." Let us hope that this is a correct view; but General Webber at Chelsea is less sanguine. He admits that most of the consumption which an electric lighting company may expect to enjoy, comes on at first, or within a year from the mains being laid past the front door. After that the process of growth is very slow; being little more than the addition of a fresh house here and there, as doubters become convinced, and residents change. New consumers have to be gone after with new mains; and this is precisely what is now found necessary both in Kensington and Chelsea. Hence we declare that, from the data given, the results of these enterprises can hardly be financially brilliant, since distribution has already to be extended while the home area wired at first is yet unprofitable. It is to be supposed that the best streets were wired to begin with; and therefore the extended mains cannot be even so productive as those already down.

Mr. W. C. Parkinson, of the firm of Messrs. W. Parkinson and Co., of Cottage Lane, City Road, will, according to *The Times*, oppose Mr. Bartley, the Conservative member for North Islington, at the next General Election. Mr. Parkinson, as our readers are probably aware, now represents the division of Islington in the London County Council.

The International Congress of Hygiene.—The Engineering Section of the International Congress of Hygiene and Demography, which is to be held in London in August next, have adopted the following as their programme: (1) Sewerage and Sewage Disposal by the Water-Carriage and other Systems; (2) Water Supply; (3) Pollution of Rivers; (4) Disposal of Town Refuse. The Committee of the Section are of opinion that the subjects they have undertaken should be dealt with as thoroughly as time will permit; and if sufficient funds should be placed at the disposal of the Central Committee, the papers and discussions will be printed *in extenso*. The acting Honorary Secretary is Mr. R. E. Middleton, of 35, Parliament Street, S.W.

FORGED TRANSFERS.

The obnoxious Forged Transfers Bill which was denounced and exposed in the columns of the Journal a couple of months ago (*ante*, p. 444) has been withdrawn, and in its stead the sponsors of the defunct Bill have brought in Forged Transfers (No. 2) Bill. This is a very different sort of measure from Bill No. 1. It is enabling, and not compulsory. By its provisions local authorities, harbour and conservancy boards, industrial and friendly societies, and companies incorporated by or in pursuance of an Act or Charter, may make compensation for a loss arising from any transfer of their securities which is effected by a forged transfer or a forged power of attorney. Under proper safeguards, there is perhaps not much to be objected to in this. One important point for consideration and determination will be the form and requirements of the resolutions by which a company will voluntarily assume a novel risk, and by which a liability uncontemplated by the Charter, Incorporating Act, or Memorandum of Association will be imposed upon a dissentient minority. Resolutions for such a purpose ought at least to be subjected to the most stringent conditions which attend the class of resolutions known as "special." That is a matter which concerns existing companies; the "new blood" in whose management may boil above that temperate degree of heat ,which hitherto has provided safe motive power for the working of the concern, and may be fired with the notion of being in the van of advancement. No matter what rubbish is hung out on offer now-a-days, somebody will rush to achieve the distinction of having been the first to grasp it. The united common sense of the body of proprietors should be enabled to defeat touch-and-go management. But in the case of companies to be formed after this Bill has become law (assuming such an event), it appears advisable that persons invited to subscribe to an undertaking should know categorically whether or not they are to guarantee subsequent purchasers against forged transfers. It should therefore be made obligatory to state in the Charter, Act, or Memorandum of Association by which the new undertaking is established, whether the provisions of the Forged Transfer Bill are incorporated. In all cases, both of companies previously existent and of those subsequently formed, there should be power secured to them to discontinue any further guaranteeing against forgeries, should they find it advisable.

As to the provision of a guarantee fund, the modes suggested in section 1, sub-section 2, will be satisfactory. In all probability, insurance will prove the most popular mode, and a new class of insurance business will spring up. But the proposal in sub-section 3, to borrow money on the security of the property in order to provide compensation, does not recommend itself. It is a startling suggestion that the degree of risk may attain very formidable proportions when it is sought to cover it by a loan charged upon the undertaking; and whether it is a fitting subject for a loan at all is very questionable. And who would subscribe to a class of security whose *raison d'être* is insecurity with no bottom to it, and the moneys provided by which are sunk and lost, and not applied to the benefit of the undertaking? Sub-section 5, which gives the compensating company the rights and remedies of the compensated person against the person liable for the loss, is all very well as far as it goes; but it does not go far enough. Unless the company is effectually secured the co-operation of the compensated person in pursuing the remedy against the party immediately liable to him, and so on through the whole chain of liability until the party ultimately liable for the loss is reached, the company may find itself in possession of a bare right which it may be difficult, if not impossible, to enforce.

A perusal of the Bill has suggested these observations upon its details; but the sum of all criticism lies in this, that the whole Bill is unnecessary, and nobody wants it at all. Bill No. 1 was begotten in the panic produced by the Barton frauds, and was a capital example of "panic legislation." Men's minds are calmer now. The birth of Bill No. 2 will evoke no interest beyond the precincts of Capel Court; and when it dies a natural death in an overcrowded session (as die it must, unless its authors mercifully put an end to it as they did to their other offspring) nobody will miss it.

THE CONDITION OF TOWN AIR.

In another part of the present issue of the Journal will be found some matter that will be regarded as of specific interest for gas engineers, in both their professional and private capacity as members of the community condemned for the most part to live in populous localities. It is a full abstract of the preliminary report of the Chemical Sub-Committee of the Town Gardening Committee of the Manchester Field Naturalists and Archæologists' Society, appointed, in the early part of the present year, to carry out a systematic examination of the atmosphere of Manchester and Salford from samples collected, and observations made simultaneously, at different points. The task set before this Committee will strike every town resident as something particularly deserving of being worked out with the utmost care; for what can be more important to us than the air we breathe? It even comes before the food we eat or the water—and other fluids—we drink; because we can help ourselves to a very considerable extent in the matter of selecting such solid nutriment and liquid refreshment as we may think to be good for us, whereas we have no choice in regard to the air that sustains our life from one minute to another. In the scope of the Journal, it has always been customary to include such questions as that relegated to this Manchester Committee, which are in the truest sense points of Sanitary Improvement. And it is somewhat surprising that outside the work done in this regard by H.M. Inspectors under the Alkali, &c., Works Act, so little real scientific investigation is directed to the important subject of what we have on previous occasions called Aërial Sanitation. The words Sanitary Science have come to signify to the popular mind something related to sewerage, plumbing, and water supply. Ventilation is occasionally discussed in this connection; but here the region of charlatanry begins, and science dies out. As we go on to the outlying province of Smoke Abatement, which is on the frontier of Sanitary Science, we find ourselves in a very queer land indeed, where the desires and assertions of the pioneers of Sanitary Reform make small headway against the gigantic evil which they essay to reduce.

It is perhaps because people have felt themselves powerless to deal with the air like they can with food and water, that they have been resigned to take it as it comes; but this is an attitude that can no longer be excused. Until a very recent time we knew so little about the air, its impurities, and the effect of the latter upon human health, that there could be no science of Aërial Sanitation, because no data for such a science were even known to exist. When people had to live in populous places, where the atmosphere was fouled with smoke, and robbed of its freshness in an infinity of ways, they put up with this drawback to the pleasures of existence and the perfection of healthy life, consoling themselves with the practice of flying into the country or to the sea-side in order to afford their lungs a chance of occasional purification. Although it was not understood how or why town air was not so healthful as that of the country, the facts that children could not live in the former as in the latter, and that adults grew stale and "peaky" if too closely confined to the atmosphere of the streets, were indisputable. Naturally enough, the earliest reliable attempts to test atmospheric air, with a view to compare the salubrity of different localities by reference to a chemical standard, were altogether futile, if not misleading. Normal air always contains a small proportion of carbonic acid gas; and this the chemists immediately dubbed an impurity. How it could be an impurity when nobody had ever breathed air that did not contain it, is a question that can only be answered by reference to the tendency of the chemical man to think he knows everything. Chemists having ascertained that this so-called impurity, carbonic acid, varied in quantity in samples of air taken from different localities, at once adopted it as the measure of the salubrity of these places. The surprising result of this hypothesis was to show that very little, if any, difference existed between the air of most pestilential places and the healthiest uplands. True, the former might show a fractional excess of carbonic acid as compared with the latter; but common sense forbade the assumption that such small differences of chemical composition of the atmosphere could be reasonably believed to explain the known diversity of localities in respect of salubrity. And when Dr. Letheby found that the air of a soda-water factory, although loaded with carbonic acid far in excess of the most crowded town, was by no means proportionately deleterious to the work-people who inhaled it, the chemical test for air fell into disrepute, and the science of Aërial Sanitation, which had been born with the carbonic acid test, entered upon a period of suspended animation from which it is only now awakening.

Bacteriology came to the relief of chemistry, which had not ceased to attack the problem of the nature and effects of the air under various conditions; and physical science brought up the rear with its exposition of the connection between dust particles and a variety of atmospheric phenomena. With the advent of bacteriology upon the scene, the importance of the carbonic acid test of the purity of the atmosphere revived. It was shown by many experiments that, while the proportion of carbonic acid in air may of itself mean little, yet it nevertheless affords a ready indication of the probable presence of other components of air to which the term impurities might be more properly applied. Thus, for example, while the air of a soda-water factory or of any factory where many open fires are scattered about may not be more insalubrious than the air of the street outside, yet the air of public and private rooms—all other things being equal—is likely to be most impure and unfit for breathing when it gives the highest carbonic acid test.

The time has come, moreover, when the fact that the air of a town can be fled from by many of its customary residents, is not held to excuse its foulness. People have begun to ask themselves in sober earnest whether it is really part of the necessary scheme of existence that town air should be so deleterious as vital statistics prove it to be. There is a growing demand, first that Sanitary Science should grapple with such practical questions as this of determining the connection between the recognizable characteristics of the air of localities and their salubrity; and then that such adventitious characteristics as are found to be undesirable should be hunted to their sources and suppressed. Our town populations increase in numbers every year; and the duty of reducing or removing the injurious influences of town life becomes yearly more urgent,

To run away from evils s not to suppress but to encourage them; and the fact that a very large proportion of a town population cannot escape from the place where they earn their livelihood is one of the strongest possible reasons for inquiring whether the air they must breathe all the year round cannot be presented to them in a fresher and more vitalizing condition.

This is by no means a wholly philanthropic study. People of moderate means will not always be able to fly from the crowded town every day and pass their leisure and sleeping hours in the suburban residences where they keep their families. There is every indication that the fashion of surburban and country residence for busy city men is already carried as far as it is likely to be. The next movement will, in all likelihood, be a concentration of population within town areas by the expedient of "flats." In order to remove one of the principal objections to this manner of living, it is necessary to purify the air of towns from some at least of those impurities which render the existence of town residents in England so joyless, in respect of atmospheric conditions.

It would be impossible to name a locality in the length and breadth of the land where the atmosphere has suffered more from every imaginable pollution than the area occupied by Manchester and Salford. In undertaking to show the local population what sort of compound it is that they have been accustomed to describe as air, the Manchester Field Naturalists' Committee have therefore gone to the root of the matter and essayed the presentment of perhaps the worst state of things atmospheric that could be found anywhere. The first thing to which the Committee directed their attention was the prevalence of sulphurous acid in the air. That there was ample reason for this selection is proved by the result; for we are told that, "during three days' fog, there was carried down per square mile in the neighbourhood of the Manchester Infirmary (by no means the worst part of the city) rather more than 1½ cwt. of sulphuric acid," besides over 13 cwt. of "blacks," and ½ cwt. of hydrochloric acid. It is no wonder that the grimy deposit found on leaves, &c., exposed to this air was found to be distinctly acid to the taste.

These inquiries will be prosecuted further, and will probably be the means of bringing home to the minds of the people the truth with regard to the nature and origin of atmospheric pollution. With regard to Manchester, independent analyses made at the instigation of the Manchester and Salford Noxious Vapours Abatement Association have revealed a startling state of things, which has roused some of the local chemical manufacturers to defend themselves. Thus it has been shown by Mr. W. Thomson that the amount of free sulphuric acid which would fall in the Ancoats district in a rainfall of 1 inch per mile would be 19 cwt., besides 10 cwt. of ammonia. With regard to the latter, Mr. Thomson remarks that it is a pity that this valuable material cannot be extracted from the coal burnt, instead of being left as an irritating component of the atmosphere. This is, in fact, a superlative example of "matter in the wrong place," being simply "dirt."

Although it cannot be doubted that much of the filth in the air of Manchester and Salford is traceable to the private fires that pour forth their smoke into the atmosphere of this low-lying and naturally damp region, it would be wrong to allow the chemical manufacturers and factory owners generally to plead this fact as an excuse for not doing everything in their power to suppress noxious aërial emanations from their works. Ancoats is not more thickly populated than many parts of London; and the area affected is, of course, out of all proportion greater in the case of London. Yet the air of the Metropolis is not so bad as that of Manchester. It used to be a saying that in every street in London may be seen at least one green tree. The statement (albeit marked with some degree of "poetic license") is not very far from the truth. But unfortunately nothing of the kind can be said for Manchester, Liverpool, Glasgow, and many other manufacturing and commercial centres; and for the very good reason that the trees could not live in such air as human beings have to breathe in some of these places. This is not a satisfactory state of things; and it is high time that the Local Authorities of Manchester set the example of doing everything in their power to ensure that the ratepayers should have good, clean air to breathe. If they can at present do nothing further in this regard, they can make the factories adopt smoke-preventing furnaces, and by selling gas and coke as cheaply as possible upon the spot, encourage householders to use smokeless fuel.

M. Edmond Becquerel.—The death of this distinguished French *savant* is announced as having taken place in Paris on Monday last week, in his 72nd year.

Mr. Alderman Holdsworth has been appointed Chairman of the Bradford Corporation Water Committee, in place of Mr. L. Robertshaw, who recently relinquished his seat in the Council. Alderman Smith Feather has been chosen Deputy-Chairman.

The Incorporated Association of Municipal and County Engineers will hold their Midland district meeting at Stourbridge on the 23rd inst., when a paper on "The Market Harborough and Great and Little Bowden Water-Works" will be read by Mr. H. G. Coales, Assoc. M. Inst. C.E., and one on "The Sewage Disposal Works of the Stourbridge Main Drainage Board," by Mr. W. Fiddian, F.S.I.

NOTES.

Glass-Cutting by Gas.

Mr. G. M. Turner writes to the *Scientific American* upon the subject of cutting glass tubes by the application of heat to a crack. He remarks that the usual direction for conducting this oft-needed laboratory operation is to file a notch, start a crack with a red-hot poker, and lead it round the tube, if of large dimensions. Mr. Turner observes that he has never been able to obtain very satisfactory results by this method; and he suggests another, which he warrants to be effectual. A piece of ¼-inch soft glass tubing is to be drawn out in an atmospheric gas-flame until the bore is reduced to something less than half a millimetre diameter, and the large end connected with a coal-gas supply by means of a flexible tube. From the small end a flame in the form of a little jet can thus be obtained, which, if held against a piece of glass tubing as one would hold a pencil, will lead a crack not in long irregular jumps, but gradually and accurately, in any desired direction. This device, although simple, gives most excellent results, not only in cutting bottles and large glass tubes, but also in cutting plate glass. Mr. Turner finds that a pointed flame, formed with a small opening, and under the ordinary pressure of the gas supply, works better than a shorter and thicker flame, formed with a larger opening and with less pressure. The idea apparently is to obtain a straight jet issuing under such pressure that its point can be applied at any desired angle to the work, whereas with a low-pressure flame the point will always coil upwards; and it is difficult to apply this part of the jet where required.

A New Method of Determining Sulphur in Coke and Coal.

A process for the determination of sulphur in coal or coke, which is claimed to be entirely new, is contributed to the *Chemical News* by W. Thomas Neilson, Chemist for the Distington Iron-Works, near Whitehaven. It is performed as follows: Mix 1 gramme of coke with 2 grammes of Na_2CO_3 and 0·5 gramme of $MnCO_3$, and place the whole in a flat platinum dish kept at a low red heat (allowing only the bottom of the dish to be red) for one hour. After this time all the sulphur and carbon will have been oxidized. The mixture is now fused, then cooled, and placed in a beaker with water, or in a basin, and 20 cc. of hydrochloric acid added. Remove the platinum dish, and evaporate to dryness, and take up with 5 cc. of hydrochloric acid and water; then filter and precipitate sulphur trioxide in the usual manner. It is not necessary to evaporate to dryness; but it is safer to do so. Testing a sample of hard Durham coke in this way, Mr. Neilson found it to contain an average of 0·77 of sulphur, which was higher than that given by other methods. It is necessary in this process to make a blank experiment, which should be performed for the same length of time, and, if possible, at the same time when the experiment is made in a muffle furnace.

The Best Paint for Ironwork.

A contributor to the *Railroad and Engineering Journal* (American) expresses a very decided opinion in favour of red lead as a preservative paint for iron and steel structures, giving reasons in support of his view. After briefly going over the range of materials in common use as paints for ironwork, and pointing out some of the shortcomings of asphalte, coal tar, and iron oxide paints, the writer observes that red lead has the property of forming with linseed oil a hard elastic coating which clings with great tenacity to the metal. This coating has no oxidizing effect upon iron, and does not act as a carrier of oxygen from the atmosphere after the paint has set; neither does it render the oil brittle, nor promote rust underneath it. When red lead fails, it is chiefly by gradually wearing away, or outside friction. It does not scale or blister, which both asphalt and iron oxide paints are liable to do; thereby requiring a thorough scraping and removal of old coats before the new can be applied. Any old red lead pigment adhering to the metal forms a permanent base for subsequent paintings, and is utilized in further preserving the metal. The United States Government specifications for the new library building of Congress, provide that "all the work not Bower-Barffed must be given one coat of pure red-lead paint before leaving the shop, and before becoming rusted." The United States Navy Department conducted experiments with immersed iron plates painted with different materials, and found red lead better than either asphalte or iron oxide. Red lead is described as setting with oil, like plaster of Paris with water. It is advised, therefore, to apply it to the work before this takes place; default in doing this being assigned as the cause of failures. In a large shipbuilding yard the process of painting ironwork is conducted as follows: The plates, &c., are first pickled in a dilute solution of muriatic acid; then passed through rapidly revolving wire brushes, which remove all scale and dirt, and leave the iron with a bright, smooth surface. The iron is then thoroughly washed with clean water, rubbed dry, and immediately coated with red lead and pure raw linseed oil. The red lead is first thoroughly mixed with enough linseed oil to form a very thick paste, which will keep for several days without hardening. This paste is thinned as wanted for use with the oil, and applied at once; care being taken to empty the pots at night. A gallon of it contains about 5 lbs. of oil and 18 lbs. of red lead; and it will cover as a first coat about 500 square feet, and for the second coat about 600 square feet.

TECHNICAL RECORD.

THE BUENOS AYRES CO-OPERATIVE GAS-WORKS.

The plate which accompanies the current number of the JOURNAL—the fourth of the series of drawings of the above-named works which we are enabled to present to our readers—shows the purifier and sulphate houses. As these do not require detailed description, we give a few particulars as to the

Exhauster, Boiler, and Pump House.

This building forms a separate block, situated between the retort-house and the purifying shed. [See General Plan, in the JOURNAL for April 28.] The exhauster-room is 40 feet long by 30 feet wide, and contains four sets of combined rotary exhausters and engines of Messrs. Gwynne and Co.'s make, each of 50,000 cubic feet per hour capacity. Each engine is provided with a gas governor acting on the throttle valve of the engine; and there is fixed in the centre of the group a vacuum governor which controls the whole four. The connections to each exhauster are 12 inches in diameter; the principal inlet and outlet mains being 18 inches in diameter. The gas-mains and steam-pipes are in subways under the floor of the house; but access can be obtained to them through man-holes. The boiler-house contains three Cornish boilers, each of25-horse power. They are fitted with both injector and pump feeds. The pump-room is situated at the farther end of the boiler-house. It contains a set of six 6-inch force-pumps worked by excentrics from an overhead shaft, and driven by an independent engine. Donkey pumps are also provided, for feeding the boilers and supplying water to the scrubbers.

Scrubbers.

The scrubbers are two in number, 60 feet high and 12 feet in diameter. They possess a specially constructed washer at the bottom, the joint design of the Engineer and the contractors.

Purifiers.

There are four purifiers, each 24 feet square, and worked by four-way valves in rotary order. The connections are 18 inches in diameter. Space is provided in the purifying-shed for duplicating the purifiers if required.

Meter and Governors.

The station meter and the governors were placed in one building, divided into two rooms. The meter is of 60,000 cubic feet per hour capacity. There are two 24-inch double-cone compensating governors, delivering into two 24-inch outlet-mains. The meter and governor are of Messrs. W. Parkinson and Co.'s make. The connections are laid in subways.

OHIO GASLIGHT ASSOCIATION.

The Annual Meeting at Zanesville.

(*Continued from p.* 894.)

A paper entitled "A Consideration of the Arguments for and against Water Gas" was read by Mr. Fred. H. Shelton, of Philadelphia, Pa. He said that he had been been led to write the paper by the misleading and erroneous opinions expressed on water gas in the course of a discussion at the last meeting of the Association, Many of these, he thought, arose from experience with inefficient apparatus, or from want of knowledge as to the proper way of working. In the course of his business, he had seen a large number of water-gas plants of all kinds, including nearly all the processes that had been put on the market. He had also watched the growth of water gas, and the steady overcoming of the objections urged against it, most of which applied only to the earlier forms of apparatus, and did not hold good in respect to that now made. As with other things, one could buy a cheap water-gas plant (with no other merit) that was sure to fail after a little time; or a good, properly-designed set of appliances, that could be easily, safely, and efficiently worked. Some of the old apparatus merely made a vaporized oil diluted with hydrogen; but he dealt only with a good, well-made, and properly-fixed water gas. It was said that water gas was dangerous because it had no smell; but it should be understood that this applied only to the crude gas. The moment a drop of oil was added to give it illuminating power, the gas became odorous; and ordinary carburetted or illuminating water gas had an odour quite as pronounced as coal gas. Some supposed that water gas was heavier than air—thus increasing the risk of poisoning in case of leakage; but the fact was that the gas varied from 0·5 to 0·7 of the weight of air according to its quality. Gas of 20-candle power was about ·600, and 30-candle gas about ·700 specific gravity. Another objection was that the gas stratified in the holder, and was therefore irregular in quality. With regard to proper water gas, he denied this, and asserted that it was quite as even and regular as coal gas. Under the present system, the runs were short, and the quality of the make varied but slightly. This small variation was quite lost by diffusion in the gasholder. The alleged greater danger of water gas, as compared with coal gas, by reason of its containing a larger proportion of carbonic oxide, was next considered; and it was claimed that a great deal of this was mere sentiment, and that neither workmen nor consumers suffered more from it than from coal gas. The men called it a "stronger" gas; and they soon learnt to be more careful, when laying services or mains, not to allow it to escape. As to accidents at premises of consumers, these were so much influenced by other factors than the quality of the gas, that practically no difference followed, whether water gas or coal gas was used. The use of wood gas was common in several parts of the world. It contained as much carbonic oxide as water gas; but nothing had ever been heard of its poisonous qualities, because no one was interested in opposing it. Poorly-made water gas was, no doubt, more trying to the meters than coal gas; but a rightly-made water gas was not. The difficulty was simply due to the want of proper fixing of the gas. If oily vapours were present, they acted rapidly on the diaphragms. On this score he submitted reports from eight of the principal meter makers, who agreed that if the gas were properly fixed and condensed, it would not affect meters more than coal gas. The complaint that water gas was more liable to deposit liquids, and to clog fittings, burners, &c., could be answered in a similar way to the last. In many cases the superheating capacity was too small; and a poorly-fixed gas was the result. The extent of superheating surface that experience had shown to be desirable was four times that provided in some of the older forms of apparatus. Some experiments made by Dr. Moore (which were quoted in full) showed that water gas made by the Granger process resisted exposure to a temperature of 25° below freezing-point better than coal gas. It only lost 21 per cent., while the coal gas lost 30 per cent. of illuminating value. Professor Wurtz had arrived at similar results. It was known that the rate of flow of gas was affected by the density; and from this it was argued that the water gas would require larger mains and supply-pipes. Taking two gases of ·425 and ·625 specific gravity respectively, the auth or quoted at length from the formula given in "King's Treatise on Coal Gas," Vol. II., and showed that the difference due to gravity was only about 8 per cent. This showed that anyone working comfortably with coal gas could change to water gas without fear of trouble this head. Even if the plant was already overworked, a slight addition to the supply pressure would meet the difficulty. If, however, things were cut so fine as this, it was evident that the limits of economical distribution of coal gas has already been passed. It was also supposed that the difference in specific gravity would necessitate changing the burners throughout a district. But water gas was better in illuminating power than coal gas; and in practice the increase of quality about balanced the reduced flow, and the consumer obtained more rather than less light. The same burners would do for water gas, although anything that recessitated an entire renewal of the burners throughout a district was not an unmixed evil. As to the supposition that the light from water gas was whiter and did not diffuse so well as that from coal gas, it had been repeatedly proved that a candle power was a candle power whether produced by water gas or by coal gas. Some fear was expressed as to the effect of increased demand upon the price of oil. He did not anticipate that the oil producers would follow such a suicidal policy as to raise the price of oil above the limit that rendered water gas cheaper than coal gas. As long as supplies of gas coal and oil existed, each would act as a useful check on the other. There was every reason to believe in the continuance of ample supplies of oil at low figures. It was a mistake to suppose that anthracite was the only fuel suitable for water-gas apparatus. Any good gas or oven coke would do as well. In the case of water gas being made as an auxiliary to coal gas, the author preferred using a relief holder, so that the pressure caused by blowing, &c., should not interfere with the seals. As for the absence of residuals from water gas, it was obvious that this was a distinct advantage, if the net cost of the water gas was as low as that of coal gas. A little tar was produced; but in a well-arranged apparatus this would only be one-third that from a similar production of coal gas. Such a small quantity could either be used as fuel for the boilers or be readily disposed of. The cost of purifying was not greater, nor were the stokers employed more intelligent, than in coal gas works.

The author next directed attention to the advantages peculiar to water gas. The first was practically unlimited candle power. Ordinary coal gas enriched with cannel or oil to 20-candle power was liable to smoke; but water gas of 25 to 30 candle power was now being supplied in many towns without this objection. This was considered to be chiefly due to the substitution of carbonic oxide in the water gas for marsh gas in the coal gas. This point was important in competing with electricity, which was placed at a great disadvantage against a good 25-candle water gas. The Company with which he was connected found it desirable to supply not less than 22, and in some instances up to 30 candle gas, at their various works. While coal gas could not be satisfactorily improved above 20 candles by cannel or oil, it could be raised to any desired extent by admixture with a rich water gas. The rapid production of water gas, and the consequent advantage in case of sudden demand, was next enlarged upon. The author said it admitted of a set of coal gas benches being kept steadily at work; the generator being depended upon to meet variations in demand. Another advantage was a considerable diminution in storeage plant, which was a direct sequence of the preceding. Water-gas plant was cheaper, required less floor-space, less yard room, and less storeage room for materials. In neighbourhoods where coke was plentiful, it was a material help as affording a

use for the surplus coke, and keeping up the price of the rest. With regard to the alleged greater trouble from naphthalene deposit, he had taken the opinions of upwards of 100 gas engineers in various parts of the country, and found a general agreement that it was very much less than with coal gas. A special advantage of the water-gas system was the small amount of labour required; and this became the more apparent as the scale of operations increased. Two men to a shift could do all the work in a medium-sized gas-works. This commended itself in cases of labour troubles or threatened strikes, apart from the fact that the regular cost per 1000 cubic feet was only one-half the rate usual in coal-gas works. In a works making 20 millions a year, the manager and the office boy could, in a case of great emergency, produce all the gas required for a few days. This reason had commended water gas to the serious attention of English gas companies; and he also knew cases where a water-gas generator had proved a great help in a time of scarce supplies of coal. Water-gas works were much cleaner than coal-gas works, as there were no clouds of sooty smoke, and the cost of repairs to the generator was much less than the corresponding charges for retorts and furnaces. While an average retort would make from 4 to 5 million cubic feet of gas, and the cost of renewal might be put at £12, representing upwards of ½d. per 1000 cubic feet, ¼d. to ½d. would cover the cost of renewing the water-gas apparatus. With this it was easy to dispense with Sunday or night work, without injury to the plant. Several circumstances effected the comparative cost of coal and water gas; but, except where gas coal was close at hand, the latter would be found the more reasonable. In many cases the introduction of water gas cheapened the coal gas by enabling better prices to be obtained for residuals; thus saving the loss due to retorts standing off, &c. From 30 to 50 lbs. of fuel per 1000 cubic feet, and more than 6-candle power per gallon of oil used, were now items of ordinary practice; and cheap crude oils of all kinds, such as "Lima crude," were applied with success. At the present time upwards of 350 companies in the States were making water gas; representing fully half of all the gas made.

Discussion having been invited, the Secretary asked if it was not a fact that the flame from coal gas was larger than that from water gas of equal photometrical value, and therefore possessed greater diffusive power. Mr. Cantine stated that, after working personally at the cupola, he had found that coal was better than coke for making water gas. A great deal depended on the condition of the fuel, as if it was loose and shallow, the gas would not be so good. He asked whether the density of the atmosphere did not affect the quality of the gas made. He also inquired as to the value of water-gas tar. Mr. Faux did better with soft than with hard coke, and was at present using as little as 30 lbs. per 1000 cubic feet of gas made. Mr. Thomas asked if there was any water-gas plant in use that worked with as little as 38 lbs. of fuel per 1000 cubic feet, including that required for raising steam. He held that the total consumption of fuel should be taken as a basis for calculation, and not that used in the generator only. Mr. Christian worked only a small plant, but did not see why the limit just named should not be obtainable on a large scale. The tar from "Lima crude" was not of much value. The President remarked that it had been shown by Professor Morton that the size of a flame did not effect its diffusive power. He had used gas coke very successfully in an improved Lowe apparatus. It developed a high heat quickly, under the blast; while a hard coke would not heat up so well. The percentage of waste was very high with the hard coke. Some information as to the difference in apparatus required for using naphtha, and that for using crude oil, would be interesting.

In replying, Mr. Shelton said the subject of the relative sizes of flame and diffusibility was a large one, with which he could not deal completely. It had been fully investigated; and those who were interested could refer to the published information. With regard to the relative value of coal, hard coke, soft coke, &c., it must be remembered that the kind of apparatus used had a great effect. With a shallow fuel bed, coal was better to use than coke; but with a deeper one, either fuel could be used. In any case, coke was not quite so good as coal. As in his apparatus he employed an artificial draught created by a steam jet, the state of the atmosphere did not at all affect his working. He agreed that good gas coke was quite as efficient as hard oven coke. He knew of no better burner for water gas than the ordinary lava tip. The Bray burner also gave good results. There was no question as to attaining the limit named by Mr. Thomas, as dozens of cases of practical working might be cited. Frequently the water-gas tar was used as fuel under the boilers. As it came from the apparatus, water-gas tar was mixed with a quantity of water; but if it was allowed to settle, good tar could be obtained. It made good pitch; and he had known it to sell for 4½d. per gallon. With a good arrangement of apparatus and double superheater, the yield would only be about one-third of a gallon per 1000 cubic feet of gas. Naphtha was a homogeneous substance, and could be worked satisfactorily at one uniform heat; but with a substance like "Lima crude," which contained many different constituents, he found that a graduated heat was the best. The oil was first vapourized, and carried in this form into the first superheater, which was worked at a low heat, and then into the second, which was much hotter. The lighter parts of the oil were first gasified, and finally the heavier.

(To be continued.)

ATMOSPHERIC POLLUTION.

In a "Note" which appeared in the JOURNAL for Feb. 10 last, reference was made to the appointment, by the Town Gardening Committee of the Manchester Field Naturalists' and Archæologists' Society, of a Chemical Sub-Committee to carry out a systematic series of analyses of the air of Manchester and Salford, from samples collected simultaneously at different points. The Committee have lately presented a preliminary report on the results of their work; and, by the courtesy of their Honorary Secretary (Mr. C. J. Oglesby), who has favoured us with a copy, we are able to give a few interesting particulars therefrom.

After stating the object of their appointment, the Committee remark that the air impurities of a great city may be divided broadly into two classes: Gaseous impurities diffused throughout the atmosphere; and small particles of solid and liquid matter held in suspension. The gaseous impurities consist of (1) an amount of carbonic acid slightly in excess of that to be found in pure country air, (2) sulphurous acid, (3) hydrochloric acid, (4) sulphuretted hydrogen, and (5) certain ill-defined organic compounds. The solid impurities or dust, consist of (1) particles of carbon and carbonaceous matter from household and factory chimneys, (2) germs of microbes, of which a certain proportion are always disease germs, (3) ammonia salts resulting from the decomposition of organic matter, and (4) *débris* resulting from the attrition of various living and non-living matter. It is only rarely that the air contains liquid impurities to any considerable extent—viz., when it is filled with fog. The fog consists of a vast number of globules of water held in suspension in the air; and these globules doubtless hold in an exceptionally concentrated form all soluble substances present. The subject of the impurity of air offering so wide a field for investigation, the Committee decided to give attention in the first instance to the following points: The composition of the air in densely-populated districts, as compared with that in thinly-populated and suburban districts; the relation between atmospheric impurity and prevalent sickness and mortality; the extent to which smoke and noxious gases are due to dwelling houses and to factories; and the character of the air during the prevalence of fog. In the "Note" already mentioned, it was stated that, in order to obtain accurate and trustworthy information of a general nature, appliances had been set up at seven different stations. The report now under notice contains a record of observations made principally at the Town Hall and at Owens College, Manchester.

The Committee decided first of all to deal with the presence of sulphurous acid in the air. The reasons which prompted this decision were various. In the first place, sulphurous acid, and the sulphuric acid to which it gives rise by oxidation, are distinctly harmful, even in small quantities, both to animals and the higher plants. It seems probable that the effects of town fog are largely due to the excess of the former impurity which it contains. Then it is definitely known that the sulphurous acid of the air arises wholly and solely from the combustion of coal, which contains from 1 to 2 per cent. of sulphur. It is a pollution especially characteristic of great cities; and in the opinion of the Committee, it is one which properly directed efforts may abolish. Lastly, the subject is one which has scarcely been touched by previous observers, owing to the difficulties of estimating sulphurous acid when it is largely diluted with other gases, as in the atmosphere.

The Committee's investigations may be divided into three sections: (1) The determination of the sulphurous acid actually present in the air during clear weather and during fog. (2) The determination of the sulphurous acid—oxidized partially or wholly to sulphuric acid—in various dust deposits on leaves, &c. (3) Observations on the variations in the clearness of the atmosphere. The apparatus used consisted of an absorbing tower containing glass beads moistened with a solution of hydrogen peroxide, and an aspirator; the latter being an ordinary wet meter altered for the special purpose in question by attaching toothed wheels to the drum, and driving them by means of a wire cord passing over a pulley and carrying a weight. The following table contains a record of experiments carried out simultaneously; the volumes of air analyzed varying from 1 to 3 cubic metres, and the results being expressed in milligrammes per cubic metre:—

1891.	Owens College.	Town Hall.
Feb. 18.—White fog, no smell of sulphurous acid (morning)	3·14	—
„ 18.—White fog, slight (afternoon)	3·72	—
„ 19.—Slightly foggy at commencement only; clear rest of time (midday)	1·95	—
„ 19.—Clear and sunny (afternoon)	2·10	—
„ 19.—Moonlight and clear (evening)	1·80	1·87
„ 20.—Clear (midday)	—	1·38
„ 21.—Clear (midday)	2·07	—
„ 24.—White fog and clear at close (midday)	3·08	4·06
„ 25.—Clear and sunny (10 to 5)	0·77	—
„ 27.—Foggy (9.30 to 12)	—	7·40
Mar. 6.—Very clear, wind (9.30 to 2.30)	0·28	—
„ 12.—Misty, bright sun (11.45 to 1.25)	0·97	—

The foregoing figures show considerable variation in the quantity of sulphur dioxide present in the atmosphere. The lowest

result was obtained on March 6, after two days' strong wind; the highest on Feb. 18, 24, and 27, on all of which days there was a considerable amount of fog. The determinations show an increase in the centre of the town.

The Committee next deal with the subject of the sulphurous acid contained in various dust deposits on leaves. The deposits were collected from snow, from the roofs of greenhouses, and from the leaves of outdoor plants in different parts of Manchester and Salford. The method employed for snow was to collect the upper layer as soon as possible after it fell, from a given area. This was then melted, and the amount of sulphuric acid, and in some cases of hydrochloric acid, in the water produced was determined. By then taking the snow on each succeeding day from a fresh plot in the same locality, it could be seen how the acid and solid deposit increased, and an estimate formed of the amount of matter carried down each day. The following records show the amount of sulphuric acid and ammonia obtained, expressed in milligrammes per square metre of surface:—

	Sulphuric Acid.				
1890.	Wilbraham Road.	York Place.	Owens College.	Infirmary.	Ammonia.
Dec. 19, 5 p.m.—Fresh fallen snow	—	—	—	10 ..	—
„ 20, 11 a.m.	—	—	5·2	19 ..	0·6
„ 20, 2 p.m.	4·3	—	—	— ..	—
„ 20, 5 p.m.	—	—	9	— ..	—
„ 21, 11 a.m.	—	9·5	—	— ..	—
„ 21, 2 p.m.	5·2	—	—	— ..	3·0
„ 22, 11 a.m.	—	—	21 [258]	31 ..	—
„ 22, 2 p.m.	7·5	—	—	— ..	6·0
„ 23, 9 p.m.—Fresh fallen snow	—	10 [93]	—	— ..	—

The amount of "blacks," where determined, is given within the brackets. Some estimate may be formed of the actual quantity when it is stated that each unit in the table represents 5·7 lbs. of sulphuric acid carried down on a square mile of surface. During three days' fog there was carried down per square mile in the neighbourhood of the Manchester Infirmary (by no means the worst part of the city) rather more than 1½ cwt. of sulphuric acid, while at Owens College the quantity was upwards of 1 cwt.; the blacks, even at the latter station, amounted to 13 cwt.; and the hydrochloric acid to about ½ cwt.

Measurement was also made of the amount of sulphuric acid carried down by rain. Through the kindness of Mr. W. T. Thiselton Dyer, F.R.S., Director of the Royal Gardens, Kew, and of Professor F. W. Oliver, of University College, London, the Committee were able to obtain a large supply of a black deposit that had formed during the last fortnight of February on the glass roofs of the plant-houses at Kew, and on Messrs. Veitch's orchid-houses at Chelsea. Dr. Oliver also secured for them some of the cotton wool through which the air of the House of Commons is filtered. These are now being examined with a view to determine the hydrocarbons, sulphuric acid, &c., they contain. The Committee explain that in a preliminary report it is impossible for them to give the whole of the details; and, indeed, the general results of the analysis of the Chelsea sample are characteristic of the rest. It contained—

Carbon	39·00 per cent.
Hydrocarbons	12·30 „
Organic bases	1·20 „
Sulphuric acid	4·33 „
Hydrochloric acid	1·43 „
Ammonia	1·37 „
Metallic iron and magnetic oxide	2·63 „
Other mineral matter, chiefly silica and ferric oxide	31·24 „

Water not determined.

The presence of such large quantities of volatile oils explains the oleaginous character of the deposits which form from London smoke; and it has been noticed that in the districts of Manchester where dwelling-houses are much crowded together the deposit has similar properties.

The leaves on which observations were made were gathered, for the most part, before much foggy weather had been experienced; and there had been no rain during the previous fortnight. In the following table are given the date and locality at which the leaves were gathered. The amount of deposit is given in milligrammes per square metre of leaf surface:—

1890.	Solid Deposit.	Sulphuric Acid.	Hydrochloric Acid.
Dec. 14.—Near Alexandra Park	131 ..	7·2 ..	9·1
„ 13.—Owens College	315 ..	10·4 ..	17·3
„ 16.—Hulme	420 ..	26·0 ..	—
„ 14.—Harpurhey	443 ..	19·0 ..	4·4
„ 14.—Infirmary	728 ..	27·5 ..	19·4
„ 14.—Infirmary	568 ..	18·3 ..	14·1
„ 13.—Albert Square	833 ..	24·2 ..	21·7
1891.			
Jan. 17.—Peel Park	374 ..	18·0 ..	—
„ 22.—Queen's Park	194 ..	17·5 ..	—

Those of our readers who are acquainted with Manchester will see that the central districts show by far the worst results, both with regard to the amount of incrustation on the leaves and the acid present in it. The leaves from several districts were actually acid to the taste; this was not, however, necessarily a sign of the presence of a large total amount of acid, but rather of a large percentage. Some idea will be formed of the injurious nature of these deposits on the leaves when it is stated that the sulphuric acid often formed 6 to 9 per cent., and the hydrochloric acid 5 to 7 per cent. of the whole.

In concluding their report, the Committee (which, it may be well just to mention here, is composed of Dr. G. H. Bailey, Dr. J. B. Cohen, and Mr. P. J. Hartog, B.Sc., of Owens College, and Dr. Tatham, Medical Officer of Health for Manchester) state that they have been asked to undertake experiments similar to those above noticed in connection with the atmosphere of London; and they intimate the likelihood of others, on the same lines, being carried out in Leeds, Liverpool, and other large towns. The results thus obtained will be of great value; and any of our readers who wish to assist in the work of the Committee, or learn more about it, would do well to address the Honorary Secretary (Mr. C. J. Oglesby), at No. 41, Ducie Grove, Greenheys, Manchester.

The Committee of the Manchester and Salford Noxious Vapours Abatement Association have recently had analyses made by Messrs. J. Carter Bell, C. Estcourt, and W. Thomson of Manchester rain water, with the object of ascertaining the relative impurities contained in the air of Ancoats and the centre of the city respectively. The analyses of the last-named gentleman have been selected for publication, as containing the greatest amount of detail. He submitted to careful analysis a sample of rain water collected at Ancoats, and compared it with a sample taken outside his laboratory in Manchester; and the following are the results in grains per gallon:—

	Ancoats.	Manchester.
Suspended matter, composed of—		
Mineral matter	13·962 ..	·085
Soot, organic matter, combined water, &c.	13·232 ..	9·245
	27·194 ..	9·330
Total solid matter in solution, composed of—		
Organic matter, combined water, &c.	2·060 ..	5·240
Mineral matter	4·380 ..	1·560
Free ammonia	0·546 ..	0·202
Albuminoid ammonia	traces ..	traces
Chlorine	0·208 ..	0·833
Oxygen contained in permanganate of potash required to oxidize organic matters, &c.—		
Acting at 80° Fahr. during 15 minutes	0·2786 ..	0·3997
Acting at 80° Fahr. during 4 hours	0·3828 ..	0·8571
Sulphurous acid	·4004 ..	none
Free acid calculated as sulphuric acid	1·0290 ..	0·2058

Commenting on these results, Mr. Thomson remarked: "The interesting points with regard to these two analyses are that each of the rain waters contains a large quantity of insoluble matter, which is a mixture chiefly of soot and mineral matter of the nature of flue dust. It is curious that the amount obtained at Ancoats is so much larger than that from Manchester. But this may be due to some extent to the blowing of the dust from the roads; and it is significant that in Manchester nearly the whole of the suspended matter is soot, while in Ancoats about half of it consists of mineral matter. The solid matter in solution is about the same in both samples, and is greater than the solid matter in solution contained in ordinary Manchester water used for drinking purposes. It is noteworthy that the organic matter in solution in the Manchester rain water is considerably greater than that in the Ancoats rain water, and, in fact, most of the solid soluble matter in the Manchester rain water is of organic nature, burning away with a sooty smell. The free ammonia exists in large quantities in both waters; these being evidently produced from the nitrogen contained in the coal, from the burning of which it is evidently produced. It is unfortunate that this valuable material cannot be extracted from the coal, such as is done in the gas-works. Both the sulphurous and sulphuric acids are much greater in the rain water from Ancoats than in the rain water from Manchester—existing to the extent of about five times the quantity in Ancoats water of that contained in the Manchester rain water; and while we found 0·4 grain of sulphurous acid per gallon in the Ancoats water, we ascertained that the Manchester water contained none at all, the whole of it having evidently been converted into sulphuric acid. The amount of free acid which would fall in the Ancoats district in an inch of water falling on the square mile, assuming it to be of the same nature as that collected, would be 19 cwt. of sulphuric acid and 10 cwt. of ammonia (NH_3); while in Manchester the amount falling with an inch of water on the square mile would be equivalent to 3 cwt. 3 qrs. 5½ lbs. of sulphuric acid, and 3 cwt. 2 qrs. 22½ lbs. of ammonia. This would indicate that the greater pollution of the rain water at Ancoats is due to chemical works."

At the meeting of the Manchester Section of the Society of Chemical Industry on the 18th ult., the Chairman (Mr. Ivan Levinstein) passed some rather strong comments on the last sentence in Mr. Thomson's report, which, he said had attracted the attention of several members of the Society, who had referred to it in terms which were scarcely favourable. He maintained that they had a right to ask, in the interests of their industries, how far the results of that gentleman's analysis justified him in drawing an inference which, if not supported by unquestionable and unimpeachable data, ought never to have been made. Mr. Thomson, by his publication, had done harm and an injustice to those who were already labouring under quite sufficient difficulties and disadvantages. He suggested the desirability of forming an association of the chemical and kindred industries of the district, for the purpose of protecting themselves against frivolous and unfounded charges brought against them, and also of mutually advising each other on the

best means and appliances for avoiding, as far as practicable, the discharge of excessive smoke. Mr. Thomson, replying to the remarks of the Chairman, said that, in the case of the water collected at Ancoats, he obtained 0·4 grain of sulphurous acid, and the water collected at the same time in Manchester contained no trace of it; and what he said was that this seemed to show that some of the pollution was due to chemical works. It might indicate the presence of large factories burning a great quantity of coal. Not only was there a considerable amount of sulphurous acid in the one which was absent from the other, but there was five times more free acid in the one than in the other. If this did not point in the direction of chemical works, he did not know what would. Dr. Bailey said the conclusion at which he had arrived was that the greater part of the impurity of the air was due to house fires. Experiments in Leeds which had extended over three years showed that three-fourths of the smoke proceeded from domestic fires, and one-fourth from works. Mr. Grimshaw expressed a similar opinion.

Mr. R. J. Sidle, the Secretary of the Hythe and Sandgate Gas Company, has been appointed Manager, in the place of Mr. G. Culver, who has resigned.

Mr. D. John Roper, the Manager of the Rickmansworth Gaslight and Coke Company, has been appointed Manager of the Rickmansworth and Uxbridge Valley Water Company. Mr. Roper has managed the water-works for the past two years under the contractors, and has now been appointed under the Company.

Measuring High Temperatures by Photography.—At the recent meeting of the Iron and Steel Institute, Professor Roberts-Austen described, in continuation of previous communications to the Institute, a method of obtaining measurements of very high temperatures by actual photographic records. This is quite a new departure in pyrometry; and its importance was recognized by the President (Sir F. Abel, F.R.S.), Sir Lowthian Bell, and M. Le Chatelier, of Paris, whose thermal pyrometer was used in the experiments. This instrument is practically instantaneous in its indications.

The Superannuation of London Water Companies' Workmen.—According to an editorial paragraph which appeared in last Friday's *Standard*, "representations are being made to the London members with reference to the position in which the workmen of the Metropolitan gas-works [*sic*] will be placed in regard to superannuation allowances in case the works are acquired by the municipal authorities." It is explained that "most of the Companies at present make superannuation allowances to men who have been a certain length of time in their service, although nothing exists in the shape of a regular system of pensions;" and it is stated that "the men fear that the advantages which the custom confers on them may not be taken into consideration in any arrangement come to for the transfer of the gas-works." As to the best of our knowledge, there is no project on foot for the acquisition of the London gas-works by the local authorities, we presume our contemporary is referring to some movement on behalf of the Water Companies' workmen, with the view of having their interests looked after in any scheme which the Select Committee of the House of Commons who are now engaged upon the inquiry as to the Metropolitan Water Supply may formulate for the transfer to some public body of the undertakings which at present furnish them with means of subsistence.

The "Parkinson" Gas Cooker.—Messrs. W. Parkinson and Co., of London and Birmingham, have just introduced into the market a new gas cooking-stove, in which are embodied several fresh features. The case of the stove is of strong cast iron, packed with silicate to retain the heat; and it is lined inside with enamelled patent steel plates. At the top of the oven a fire-brick is fixed, which throws down a great heat, and equalizes the temperature. This is an important improvement; and it is found that by its aid pastry and bread can be baked very evenly. The oven is splendidly ventilated. There is a good clear opening at the bottom; and in the front part of the fire-brick at the top, holes are provided by which the products of combustion pass into the space between the roof of the stove and the fire-brick, escaping by a pipe at the back. Between the grill and the oven, the space is large, and free from all impediments; and this will be found of considerable advantage. A special feature of the stove is the double grill, which provides two large oblong surfaces of great heat. The griller gets intensely hot very rapidly. Underneath it there are little projections, which are heated to redness almost immediately the gas is lighted; and as it is made of open-work, boiling and toasting or grilling can be carried on simultaneously. The upper edges of the bars at the top of the stove (which are moveable) are serrated, and by this means a uniform heat is obtained on the bottoms of the boiling utensils. These cookers have already been adopted by The Gaslight and Coke Company, as well as by many prominent gas companies. Those who have tried the stoves speak well of their efficiency and economical working; and it may be added that samples which we have seen show that Messrs. Parkinson and Co. are determined to maintain, in this class of goods, the reputation they enjoy for good workmanship and durability.

REGISTER OF PATENTS.

Gas Motor Engines.—Fielding, J., of Gloucester. No. 6912; May 5, 1890. [8d.]

The improvements to which this invention refers are, in part, more especially applicable to engines of the four and six stroke cycles, and in part to gas motor engines of other types.

The improvements were originally divided under the following six heads: (1) Improved means for obtaining greater expansion of the working charge. (2) An improved form of admission and exhaust valve. (3) An improved governor for regulating the admission of gas. (4) Improvements in hot-tube igniters. (5) An improved form of lubricator giving a constant delivery of oil. (6) Improved methods and apparatus for facilitating the starting of gas motor engines.

According to the first part of the invention, a separate chamber is provided in connection with the working cylinder, fitted with a valve, which at certain times opens or closes its connection therewith. This valve is operated by suitable means, such as a cam. Its action is as follows: Assuming that a charge has been drawn into the cylinder, and that the piston is about to perform its compression stroke, the valve will be opened, so as to allow a portion of the charge to enter the separate chamber. At any desired point of the compression stroke, the valve may be closed—the piston thereafter compressing the remaining portion of the charge in the cylinder, where it is ignited; and on the following acting stroke it expands to the full volume of the cylinder, and the exhaust stroke then takes place. This expels the products of combustion; and at some part of the next charging stroke the valve is reopened, so as to permit the pent-up contents of the chamber to re-expand into the cylinder. By retarding the opening of the admission-valve, advantage may be taken of whatever pressure may exist in the separate chamber to assist the forward movement of the piston. The amount of charge thus shut in the separate chamber may be varied, for the purpose of governing the engine, by using a governor, acting on suitable stepped or sloping cams, to alter the timing of the valves.

The second part of the invention relates to a special form of combined admission and exhaust valve, consisting of a mitre valve working upon a seat preferably formed on a removeable valve-box bolted to the working cylinder, so that it opens inwards to the combustion chamber. A spindle or stalk is formed on the valve, passing through a sliding bush or collar, held up to the under side of the valve-head by a spring abutting upon a collar or shoulder on the valve-spindle. The sliding bush is turned at one part to fit freely in a bored part of the valve-box, thus separating an exhaust port from the inlet port or chamber. At another part—where it abuts against the under side of the valve-head—it is reduced, so as to leave an annular space between the reduced part and the inner diameter of the valve-seat. The annular area permits the passage of the waste products to the exhaust port when the valve is first raised from its seat. The shoulder formed at the junction between the larger and smaller diameters of the sliding bush is caused to act as a valve, for the purpose of closing the exhaust outlet after the main valve has been raised through about two-thirds of its total lift. During this portion of the lifting movement, the valve and sliding bush move together until the shoulder comes in contact with a seat closing the exhaust; and during the remaining movement of the valve, the sliding bush remains stationary, and, in consequence, a communication is formed through the sliding bush with the inlet passage or chamber for the admission of the working charge. The reverse motion of the valve first closes the admission, then re-opens the exhaust, and finally closes all outer communications leading to the combustion chamber.

The operations of the valve in relation to the movements of the piston are as follows: Assuming the piston to have reached the end of its acting stroke, the valve is raised from its seat to about one-third of its total lift, which allows the fullest area for the escape of the waste products. While the piston is making its exhaust stroke at the end of this stroke, the valve will have been raised another third of its lift, closing the exhaust outlet. The remaining third admits a fresh charge during the suction stroke, at the end of which the valve is quickly dropped to its seat, while the crank is passing the outer dead-centre. Compression and ignition then occur while the valve remains closed.

The third part of the invention is abandoned.

According to the fourth part, the lubricator consists of a closed air-tight chamber for containing the oil supply, having a tray or trough outside formed in the same casting. At the base of the chamber a hole is drilled through the wall of the chamber, leading from its lower port into the tray; and through this aperture the oil escapes, maintaining a constant level in the tray.

According to the fifth part of the invention, in the Bunsen burner used for heating the igniting tube, the mixture of gas and air issues laterally towards the centre, from an annular groove or chamber surrounding the tube; thus impinging directly upon it. Air is supplied in suitable proportions below and above the flame. To ensure perfect combustion, the usual chimney or tube lined with non-conducting material is provided above the burner, which is arranged so that falling flakes or scales, from the tube may drop clear, without danger of clogging up the gas or air passages; while space is allowed beneath it to permit of a suitable tool being used to screw the tube in or out.

To reduce the labour of starting gas motor engines, it is frequently the practice to provide some means of temporarily reducing the compression of the charge; and in such cases, where the timing of the ignition depends not upon the action of the igniting valve, but upon the capacity of the tube beyond the heated part, it is advantageous to have some convenient means either of increasing the space beyond the heated part, or of reducing the distance between the heated part and the combustion chamber, so that, notwithstanding the lower compression, the combustible mixture will be able to reach the heated surface to effect ignition. According to this part of the present invention, on the outer end of the ignition tube is attached a chamber of suitable capacity; and a cock or screw-plug is provided for the purpose of opening or closing communication with the tube. Thus, when starting with reduced compression, the cock would be opened until such time as the engine had got up sufficient speed to permit of the full compression being used, when it would be shut. Or two passages, one

longer than the other, may be arranged to lead from the hot tube to the cylinders—either or both being fitted with means for closing. When starting with low compression, the long passage will be closed; the other being open until the engine is fairly started and higher compression used, when the action of the passage may be reversed by closing the short, and opening the long passage. Thus in either case, by suitably proportioning the parts, correct timing of the ignition may be secured.

In cases were the engine is started under normal conditions of compression, the chamber at one end of the hot tube is also advantageous; but it is employed in the reverse manner. Thus the cock is left open when the engine is running, and closed for starting, so as to retard the ignition until the crank has passed the dead-centre. This avoids risk of premature ignition, which might be dangerous to the attendant.

When, for the purpose of starting gas motor engines, an explosive charge at or slightly above the atmospheric pressure is introduced into the cylinder, the hot tube as usually employed is unsuitable for igniting the charge, and recourse is had to electricity for this purpose; but according to a modification of the chamber fitted to the end of the hot tube, as already described, such charges may be readily ignited. This modification consists in the provision of an escape-valve, which may take the form of a hinged flap, opening inwards by gravity, but arranged so that, on sudden pressure being created in the chamber, it will shut. The charge is ignited in the following manner: The pipe preferably placed at the top of the cylinders, and being at a bright red heat, the cock and flap valve being both open, an explosive mixture is introduced to the cylinder under a slight pressure. As soon as the cylinder is filled, a draught being created in the tube by the heat, the contents will rise up through the tube, and escape by the valve until the explosive mixture comes in contact with the heated surface of the tube. This causes an explosion, the pressure of which shuts the valve, and sets the engine into motion with sufficient force to bring the ordinary cycle of operations into action.

The last part of the invention is for facilitating the manual starting of gas motor engines of considerable power. According to the usual practice, an engine has to be turned through one or more complete revolutions; the power required to compress the charge being considerable, particularly while the crank is passing the dead-centre prior to ignition. There is a further difficulty involved in this method of starting when an engine is fitted with a hot-tube igniter, and when the timing of the ignition depends upon the exact localization of the heated surface of the tube—a risk of the ignition taking place before the crank has actually passed the dead-centre prior to the commencement of the acting stroke; and this involves possible danger to the attendant, owing to the engine being driven violently in the wrong direction. According to this part of the invention, the operation of starting an engine will be as follows: It being assumed that the engine is standing with the crank at the dead-centre (corresponding with highest compression)—no charge, however, being in the cylinder—the valves being all closed, as will be the case under the usual conditions of working, the igniting tube being heated and the gas turned on, a suitable detent or pawl is put into gear, for the purpose of temporarily causing the air and gas valves to be opened, while the fly-wheel is turned through about half a revolution, which may be done at a moderately slow speed. At the end of this movement, the engine automatically throws the pawl out of gear, and allows the valves to close. Any desired portion of a full charge may then be drawn into the cylinder by suitably timing the closing action. Now by turning the fly-wheel backwards, through (say) about one-quarter of a turn, the charge will be ignited by the hot tube, and the consequent explosion will set the engine in motion; the ordinary cycle coming at once into operation.

Automatically Delivering Proportionate Quantities of Oxygen or other Gaseous Body into Gas Purifiers, irrespective of any Pressure in such Purifiers or other Vessels.—Newton, C. B., of Shrewsbury. No. 7714; May 17, 1890. [1s. 1d.]

The object of this invention is to construct apparatus whereby a proportionate quantity of oxygen, air, or other gaseous matter may be delivered to the gas purifiers or other vessels automatically, in order to revivify the purifying materials employed, or to mix similar gaseous matter with ordinary illuminating gas in such proportion as may render it suitable for various purposes.

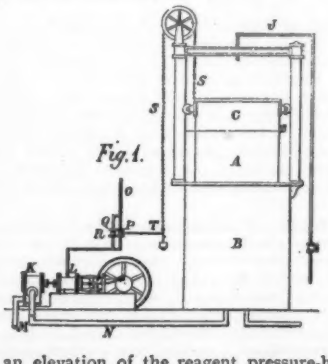


Fig. 1.

Fig. 1 is an elevation of the reagent pressure-holder, engine, and pump. Fig. 2 shows a front elevation, plan, and part section of the meter for measuring the gaseous reagent, with regulating valves, and electric apparatus. Fig. 3 is a sectional elevation of the governor and its appliances. Fig. 4 is an elevation of the adjustable water overflow apparatus attaching to the tank on the top of the reagent holder. Fig. 5 is a plan of the hand-wheel and box hereafter referred to.

To carry out the invention in reference to small or medium sized gas-works, a gasholder is used, both as a store for oxygen and for the purpose of giving the necessary pressure; the holder working in a tank

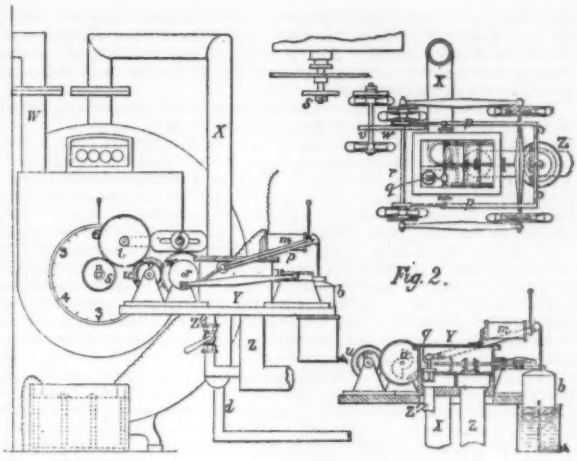


Fig. 2.

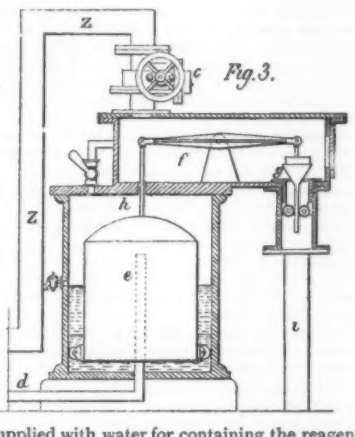


Fig. 3.

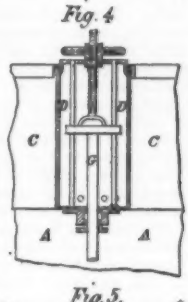


Fig. 4

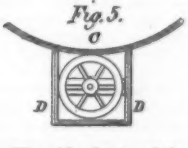


Fig. 5.

supplied with water for containing the reagent. The side sheets of the holder are carried above the crown sheets, so as to form a water-tank on the top of the holder, such as in fig. 1. The quantity of water held in this tank determines the pressure at which the reagent is delivered; and it is regulated by apparatus shown in figs. 4 and 5. On referring to these, it will be seen that the apparatus consists of a box D fixed to the side of the tank C; holes being made near the bottom by which the water can flow from C into D. Through a stuffing-box in the bottom of the box, there works an overflow-pipe G, which is raised or lowered by a screw operated upon by a hand-wheel, the boss of which forms the nut corresponding with the screw.

In large gas-works it may be desirable, says the patentee, to store the gaseous reagent in an ordinary holder, and use a small one (such as fig. 1) for giving the necessary pressure. The gaseous reagent may be pumped from the storeage holder into the smaller one A by a pump K, worked by an engine L; M being the suction, and N the delivery pipe of the pump by which A is charged. O is the pipe coming from the boiler, with a valve P inserted; there being a branch-pipe Q, which has also a valve R at the point shown. This valve is opened only to start the engine; but as soon as it is once set to work, the valve is closed—the quantity of steam being regulated by the rising and falling of the holder A, which operates through a chain upon a lever T, so as to open or close the valve P.

The electric contact-maker is constructed in such a manner as to prevent any danger arising from "sparking." It is formed of a tubular glass ring, into which two wires are fused a short distance apart. A small quantity of mercury is placed in the tube, for the purpose of connecting the ends of these two wires. This ring is fixed to one of the spindles of the station-meter index, and revolves with it in a vertical plane. The mercury within the tubular ring being, by the force of gravity, prevented from revolving with the ring, remains at the bottom; so that at every revolution of the ring, the ends of the wires pass through the mercury—thus closing the circuit. One of the wires fused into the ring is connected to the index finger, so as to form a metallic connection to "earth" through the mass of the meter and connecting-pipes. The other wire is connected to a metallic ring, which encircles the tubular glass ring. Against this metallic ring a metallic spring constantly presses (this spring and metallic ring not being in metallic connection with the meter). An insulated wire is carried from this spring to the place where the other part of the apparatus is fixed, and there connected to the electro magnet *m* (fig. 2). This attracts its armature when the hook at the end is released, and the lever *p* slowly descends and opens the pilot-valve *q*, thereby causing a small quantity of reagent to pass on to the governor through the pipes Z and Z^1. This flow of gaseous reagent causes the reagent meter to move; the movement of the meter being communicated to the shaft *r* by toothed wheels *s*, *t*, *u*, *v*, and *w*. The shaft *r* revolves in a right-hand direction; and its revolution communicates a sliding motion to a crosshead by means of a crank and connecting-rod; the motion being conveyed to the main valve. The movement of the reagent meter thus allows the required quantity of gaseous reagent to pass on to the governor by the pipe Z, and then closes. While the valve is opening, the cycloids or cams *a* on the shaft *r* depress the ends of the lever *p*, raise the lever and with it the hook already mentioned, and the air vessel *b*, thereby closing the

pilot-valve q, when the hook attaches itself to the armature and holds the lever p up. This keeps the pilot-valve q closed until the next closing of the electric circuit. The quantity of gaseous reagent passing through the apparatus during each period of action can be varied as required by changing the wheels s and u.

The gaseous reagent, after leaving the automatic apparatus, passes on to the regulating-valve c of the governor (fig. 3) by the pipe Z. The use of the governor is to maintain a constant difference of pressure between the inlet and outlet of the regulating-valve. Its action is as follows: A small pipe d from the inlet of the automatic apparatus is carried to the under side of the bell e; while the gaseous reagent is conveyed by the pipe Z to the valve c, from whence it enters the chamber f. The weights on the valve g may be assumed to be so adjusted that the weight of the bell e is equal to a pressure of $\frac{1}{2}$ inch of water. The pressures in the pipes Z and d are both alike (say, 12 inches), and for the moment it may also be assumed that the bell e is raised, so as to close the valve g when the pressure of 12 inches in the pipe Z will extend into the chamber f and space h. Now if the bell e is free to descend, it will do so because the pressure on its crown is equal to the pressure underneath; and its own weight being equal to $\frac{1}{2}$ inch of pressure, it will fall and open the valve g so as to allow the gaseous reagent to pass on through the pipe i to the purifiers. The opening of the valve g allows the gaseous reagent to pass, and so reduces the pressure in f and h to the extent of the weight of the bell. The bell therefore is in equilibrium; the pressure under the bell e being 12 inches, and the pressure in the chamber f and space h being 12 inches *minus* the weight of the bell e. The action of the governor is such that whatever the pressure may be on the inlet side of the regulating-valve c, it is reduced on the other side of the valve to the extent of the weight of the bell. If the opening through the valve is equal to the area of a $\frac{1}{2}$-inch pipe, and if there is a difference of $\frac{1}{2}$ inch of pressure between its inlet and outlet, then the quantity of reagent passing per hour through the valve is equal to the quantity that would flow through a 1-inch pipe per hour at a pressure of $\frac{1}{2}$ inch of water, notwithstanding any variation of pressure taking place in the pipe i, which conveys the reagent to the purifier. The valve c thus becomes an efficient regulator. The variations of pressure in i, due to the gas in the purifier, have no effect upon the governor so long as the pressure in the pipe Z is the greater.

The gaseous reagent is delivered from the holder A (as already described), and enters the reagent meter by W, comes out by X, passes through a regulating-valve, and from thence to the governer by the pipe Z—the regulation being effected by the valve just mentioned, and not by the valve c of the governor. As in the former case, the reagent flowing through the reagent meter causes it to move; the movement being communicated to the shaft r by the wheels s, t, u, v, and w. On the shaft are fixed two discs, which revolve in a right-hand direction. The regulating-valve is a wing-valve, and on its spindle a toothed quadrant is fixed. A worm secured to the spindle engages with the quadrant; and at the other end of the spindle a small wheel is fixed. The spindle is so supported that the wheel hangs between the discs, but does not touch them. The hanger is prolonged below; and an armature, which is a permanent magnet, is fixed to the bottom of it. Two electro-magnets are placed one on each side of the armature; and on the end of the shaft r, a commutator is fixed. This commutator is similar to that attached to the station meter; and its action may be described as follows: When the apparatus is working correctly, the pointers will revolve together, and no electricity will pass; but supposing the station meter increases in speed, the speed of the reagent meter should increase also, and automatically. When the pointer of the commutator on the station meter moves faster, it will cause a current of electricity to the magnets, and thence to earth. The armature is attracted to one of the magnets; and this movement presses the wheel against one of the discs, and the shaft then revolves in a left-hand direction. This motion moves the toothed quadrant, opens the valve, and thus allows more reagent to pass through the meter, when the commutators will again revolve in unison. If the station meter goes slower, the pointer on the commutator causes a current of electricity to flow through the wire in the contrary direction. The magnet then attracts the other armature; and the wheel is pressed against the other disc. This communicates a right-hand motion to the wheel, and the valve is closed a little; the reagent meter goes slower; and the commutators again work in unison.

APPLICATIONS FOR LETTERS PATENT.

7815.—Potts, S., "Improvements connected with endless conveyors for coals and other materials." May 6.

7945.—Hutchinson, W. S., "Improvements in furnaces, and devices and attachments connected therewith, for the production and combustion of water gas." May 8.

7947.—Pain, A. C., "An improved gas-fitting." May 8.

8032.—Horn, W. W., "An improved gas-engine." A communication from C. and E. W. Vanduzen. May 9.

Extension of the Newcastle and Gateshead Gas-Works.—Owing to the continued increase in the consumption of gas, several extensions are about to be carried out in connection with the Redheugh works of the Newcastle and Gateshead Gas Company. The chief of these additions is the construction of a gasholder tank, 183 ft. 10 in. in diameter, and 44 ft. 3 in. deep.

The Emission of Sulphuretted Hydrogen from Gas-Works.—At the Northwich County Court last Wednesday, Mr. A. E. Fletcher, the Chief Inspector under the Alkali Works (Regulation) Act sued the Northwich Gas Company to recover £20 as a penalty incurred by them in having permitted the discharge of sulphuretted hydrogen from their works and not having applied the best practical means of preventing such a discharge. Dr. E. G. Ballard, of Chester, the Local Inspector under the Act, detailed the condition of things found on a visit to the gas-works in February last, and said there was a danger to life from the emission of sulphuretted hydrogen. The gas emitted was so strong that he had to hold his breath. His Honour said, as it was not shown that any actual harm was done, he would reduce the penalty to £10, and as to costs, £3 should include costs and Court fees.

CORRESPONDENCE.

[We are not responsible for opinions expressed by correspondents.]

Walker's Over-Ground Gasholder-Tanks.

Sir,—It was not my intention to have troubled you further in this matter; but, in view of Mr. Cripps's letter in your issue of the 5th inst., I crave some further indulgence.

When a gentleman occupying Mr. Cripps's position commits himself to certain statements, one is naturally supposed to infer that he is master of his facts; but I regret to find that this is not the case. In a letter to the Journal for April 21, Mr. Cripps, in a general manner, condemns the Intze system of gasholder construction; and, on being appealed to, to make clear the disadvantages, he triumphantly points to the deplorable case of the destruction of the Constantinople holder, and further, in a somewhat personal manner, to our Flensburg holder erected in 1890.

Now, it may interest Mr. Cripps to learn that the Constantinople holder was not erected on the Intze principle, but was an ordinary flat-bottomed overground tank; and it will no doubt be gathered (I speak with all due reserve on this point), from the exhaustive enquiries that are taking place, that the failure of the tank was due to a disregard of the ordinary coefficients of safety, and that the tank burst from the actual water pressure—the sides being too thin to stand the head of water. I am further desired by Herr Blum, the Director of the Berlin Anhaltischen Engineering Company, Martinikinfelde, to state that Herr Klönne, the maker of the Constantinople holder, does not hold any license for the construction of Intze holders; the only firms holding licenses being his own and Herr Neumann, of Aachen.

As regards the Flensburg holder, surely Mr. Cripps cannot maintain that, because difficulties were experienced with the foundations, the entire system on which the holder is constructed is to be condemned; and it is absurd to suppose, as stated by Mr. Cripps, that security against weak foundations is claimed as one of the advantages of the system. When one considers that the whole weight of the tank is resting on its narrow annular base, the veriest tyro must know that a firm foundation is indispensable.

If Mr. Cripps imagines that the Intze holders are constructed on hap-hazard principles, I would respectfully refer him to the pamphlet containing the description and calculations of the Charlottenburg holder; and he will gather that the strains and weights are calculated with the greatest mathematical accuracy. Surely, if the principles involved in the construction of these holders are so bad as Mr. Cripps would have us believe, a firm of Messrs. C. and W. Walker's standing would scarcely have turned their attention to them.

We are all greatly indebted to Mr. Cripps for the pains he has taken to place so clearly before us, as he has done on several occasions, the strains, &c., &c., to which gasholders and tanks are subjected; and I regret very much if, in the course of my correspondence, I have said anything that could be construed into disparagement.

Professor Intze is a scientific constructor of the highest order, and is doing the same good work in Germany that Mr. Cripps has done in England; and it is a matter of extreme regret to me that such an authority as Mr. Cripps condemns, on what I call inadequate and untenable grounds, the entire system of the Intze construction.

In conclusion, it is wrong to imagine that the Intze system can only be applied to holders of small dimensions. Large holders are, for some reason, unpopular in Germany. But an Intze holder having a capacity of nearly 1½ million cubic feet, has been erected for Herr Krupp at Essen; and it is a remarkable engineering achievement, inasmuch as the new holder was erected over the old one, which continued to work under the dome or cupola of the new tank.

Danish Gas Company, Copenhagen, May 14, 1891. F. D. Marshall.

Reduction in the Price of Gas at Hebden Bridge.—The Hebden Bridge Gas Company, at their meeting on the 11th inst., reduced the price of their gas by 3d. per 1000 cubic feet.

Electric Lighting by Gas Companies.—Arrangements have been made by the municipal authorities of Metz with the Gas Company of that city for the establishment of an electric light station, to be worked by water drawn from the Moselle.

Electric Lighting of Amsterdam.—A concession has been granted to the Electra Society for the electric lighting of Amsterdam. The erection of a central station and the laying of the mains for a capacity of 20,000 lamps of 16-candle power has been placed with the Helios Company, of Cologne, licensees of the Ganz system. The installation will comprise three alternate-current 320,000-watt dynamos separately excited, and a dynamo of the same system of 160,000 watts. The first will be driven by two steam-engines of 600-horse power each, and the fourth will be coupled direct to an engine of 300-horse power. The central station will be established about two miles from the middle of the town.

Northern Coal Trade.—The coal trade of the North is still excited and both the strikes on the Continent and the holidays have tended to make coal scarce and rather dearer. Best Northumberland steam coal is very difficult to obtain for ready delivery, and commands about 12s. 9d. to 13s. per ton, free on board; all the collieries being well employed, with sales into June. Second class and small steam coal are proportionately high; and are also in good demand. Gas coal is firm, especially for prompt delivery; and for best Durham qualities 10s. per ton is asked. The recent large contracts are, however, known to have been allotted at lower prices; about 8s. 9d. to 9s., it is said, having been the average. There is a very fair inquiry for gas coals for the time of the year; and it is quite probable that, with the export season at hand, it will be maintained. Bunker coals are quiet, for there are still many steamships laid idle. For manufacturing coal the demand is steady; but the price is, if anything, easier, as more coking coal has been thrown on the market. For best blast-furnace coke the price is a little firmer, at about 17s. per ton, free on board. There is no alteration in gas-coke; but the production is much less than it was.

PARLIAMENTARY INTELLIGENCE.

THE METROPOLITAN WATER SUPPLY INQUIRY.

Fourth Day—Wednesday, May 6.

(*Before Sir* MATTHEW WHITE RIDLEY, *Chairman; Mr.* T. H. BOLTON, *Sir* ALGERNON BORTHWICK, *Mr.* BRISTOWE, *Mr.* H. W. LAWSON, *Mr.* J. W. LOWTHER, *Mr.* MURDOCH, *and Mr.* ROWNTREE.)

METROPOLIS WATER SUPPLY BILL.

On the re-assembling of the Committee this morning,

Mr. RICKARDS said that one of the members asked on the previous day for the figures with reference to the eight Vestries who were not in accord with the Bill. Mr. Wilkins had obtained these figures, and would now give them.

Mr. *H. Wilkins* was then recalled, and stated that the total population of the districts of the dissentient Vestries was 1,128,361, and their rateable value £8,037,669. Of these, some proposed an independent supply, and others were in favour of the County Council being the Water Authority.

In cross-examination by Mr. MEYSEY THOMPSON (for the Beckenham and Bromley Local Boards and the Richmond Corporation), witness said the promoters of the Bill had considered the question of the sale or transfer of those portions of the water-works which were outside the Metropolitan boundary to the Local Authorities within those districts; and they came to the conclusion that it was impossible at the present time to adopt such a course. The Beckenham Local Board proposed to unite for the purchase of mains within their district; but then they would have no supply of water. The question was an engineering one, on which he was scarcely qualified to speak; but he conceived that it might seriously prejudice the supply of water throughout the Metropolitan area.

Mr. MEYSEY THOMPSON: Would you object to the insertion of a clause providing that, if a Committee of Parliament think it right to pass a Bill enabling the Local Authorities to acquire the portions of the water-works within their respective districts, you should not oppose the Bill, but be merely authorized to oppose, if necessary, on clauses?

Witness said that if this were conceded to the districts within the area of the Kent Company's supply, they would have to concede it to other Suburban authorities; and this might cripple the general supply. By the Bill it was intended to authorize the Water Trust to take as much water as they pleased from the Kent Company's supply to serve any part of London.

The CHAIRMAN said it was quite possible that they had power to do so at present within the provisions of the present Kent Company's Act. If the Kent Company had certain parliamentary powers with regard to the total quantity of water that might be taken, then those powers would be continued to the Water Trust, and they might send the water to any part of London.

Mr. MEYSEY THOMPSON said the existing power of the Company was to take water up to a certain amount for the supply of their own districts; but the Water Trust asked that they should take it not only for that district but for the whole of London.

The CHAIRMAN: Are there any limitations in the Kent Company's Act as to the quantity of water they may take?

Mr. RICKARDS: May they supply water in bulk to outside districts?

Mr. MEYSEY THOMPSON: I am told not. It is obvious that a very great injury may be done to the people in the district if the Water Company who supply them should be authorized to serve any other part and take more water from the district than they have to spare.

The CHAIRMAN: The point I wanted to know was as to whether there is any limit fixed as to the minimum number of gallons per diem, and so on.

Mr. MEYSEY THOMPSON: No.

The CHAIRMAN: Their limits are the wants of the district within which they have parliamentary power?

Mr. MEYSEY THOMPSON: That is so.

Mr. RICKARDS: I may point out, with regard to the district itself, that the Water Trust will come under the same obligation that the Water Company are under at the present time, to supply it before they serve outside districts. The service of the district itself would not be injured by the transfer of the powers of any Company to the Trust.

Cross-examination continued: So far as the wants of the district would allow, the Trust would, under the Bill, take powers to send the water to other localities; but he could not say what was the intention of the Trust in the matter, or whether or not they would exercise those powers.

Mr. RICKARDS said that, with regard to the Corporation of Richmond, the proviso which the witness quoted on the previous day was utterly insufficient for them.

Witness said there was this difference between Croydon and Richmond, that Croydon was not supplied by the Lambeth Water Company, except in a very small portion of their area; whereas Richmond was within the area of the Southwark and Vauxhall Water Company. He saw no reason at all for not including Richmond within the scope of the Bill. Besides, the people of Richmond might object to being excluded.

Mr. MEYSEY THOMPSON: I can assure you that they will not.

Witness said he was aware that the Southwark and Vauxhall Company had been placed by Parliament under the obligation of supplying a certain quantity of water in bulk to Richmond, after the Company had applied for power to include that town in their area of supply—an application which Parliament refused. He also knew that they had spent about £70,000 or £80,000, under the authority of the Local Government Board, after the West Middlesex Company had said that they were not able or willing to supply them with water, on the ground that the only mains they had that ran through the district were those used for carrying unfiltered water to the reservoir; and therefore they declined to exercise their powers.

Cross-examined by Mr. BIDDER (for the Corporation of Croydon and for the New River Company): It was not proposed to do anything to interfere with the Croydon Corporation supplying water within their own limits. This right was safeguarded by a clause in the Bill. The question of handing over to them the small fragment of the district now supplied by the Lambeth Company within the municipal boundary was a matter of detail, and not of principle.

Mr. BIDDER: It is a matter of principle. Is it not the principle of this Bill that the Local Authority should have control over the water supply?

Witness: Yes; but we do not take the power to supply Croydon at the present time.

Cross-examination continued: With regard to the New River Company, the scheme of the Bill is to offer to the shareholders in the various Companies either cash or water stock; the latter being declared to be personal estate. He was aware that the shares of the New River Company were real estate.

Mr. BIDDER: And they are subject to all the incidences of real estate. How are you going to get over that?

Witness: It is necessary to adopt one uniform principle with regard to the whole area. The New River Company, large as is its area, are only a small portion of the entire district; and it was thought expedient to assimilate the Company to the other parts of London.

But it is rather a violent step for the sake of uniformity to alter the incidence of the whole of that property?—There is nothing to prevent the shareholders taking cash instead of stock, and investing it in real property.

But you have not provided any machinery for that?—Except that we give the shareholders the option of taking cash in lieu of stock, which also is personalty, but can be converted into real estate.

Cross-examined by Mr. CRIPPS (for the Regent's Canal City and Docks Company). He was afraid that the fact that the Regent's Canal Company had power to supply water for irrigation and manufacturing purposes had been overlooked on the proposal to take exclusive powers of supply for all purposes. He knew now that the Company derived an income of something like £3000 a year from this source; and he should be prepared to continue to them their power—thus leaving them in their present position.

In cross-examination by Mr. MOON (for the Grand Junction Canal Company), witness said the observations he had made with regard to the Regent's Canal Company would apply to the Grand Junction Canal Company.

Cross-examined by Mr. MOON (for the Kent Water-Works Company): He was aware that the area of supply of the Kent Company was 170 square miles, of which only 30 were in the Metropolis; but the whole of this was included in the area of supply as defined by the Bill. He could not say that there was no desire on the part of the local authorities for a change in the present system of supply, as Beckenham and Bromley certainly wished to purchase the existing systems, and the Woolwich Local Board also petitioned in favour of the Bill.

Cross-examined by the Hon. SYDNEY HOLLAND (for the Watford Local Board): Mr. Grover, the Engineer, had verbally recommended the inclusion of the Rickmansworth Company in the scheme, and he had also made a written report. All previous Bills dealing with the subject of the water supply proposed to include only the eight Metropolitan Water Companies. The proposal of the Bill to include Rickmansworth was made not only on the recommendation of Mr. Grover, but on reports by the Duke of Richmond's Commission, and other reports on the subject, which were public property. The Duke of Richmond's Commission did not specifically suggest the inclusion of Rickmansworth, but it pointed to the taking of water from the chalk in that part of London.

Mr. HOLLAND: Mr. Clutterbuck, a gentleman of great experience, to whose evidence the Duke of Richmond's Commission attached much weight, said that if water were taken from the chalk the river would cease to flow. That is not much in your favour, is it?

Witness: I do not know if that has been corroborated.

Did Sir R. Rawlinson, who has been so much quoted, say before the City Corporation anything in favour of taking water from the Watford district?—No; he says the watershed of the Thames will provide sufficient water for London for all time to come.

What did he say was the "valley" of the Thames. Do you call Rickmansworth the valley of the Thames?—It is in the watershed of the Thames. He said it was available for a very large supply of water. Speaking generally, I think the evidence shows that the Rickmansworth district has a large quantity of water which might be made available.

I see that he suggests that 3 million gallons a day can be taken from one chalk well. Do you know how many wells you propose to make at Rickmansworth?—That would not be in the Bill. It would be a matter for the Water Trust.

Do you not know that all the wells in the Watford district are lower now than they have been for years, and that there are three Companies now taking water from the district?—No.

We may take it, then, that Rickmansworth has been included by you without any inquiry as to the effect on the districts just outside?—Yes; you may say that.

In cross-examination on behalf of the West Kent Main Sewerage Board, witness said that powers were taken in the Bill to rate the whole of the proposed district for the new supply. He did not admit that there was a reasonable possibility, if not probability, that a fresh supply would have to be provided for London; and, notwithstanding that the district of the Sewerage Board was geographically, politically, and sanitarily disconnected from the Metropolis, he was not prepared to make any exception in their favour.

Mr. PEMBER said that, as the London Water Companies were in this matter the real defendants, their case ought to come last, and they ought not to be "sandwiched" between the promoters of the Bill and certain opponents in the shape of the County Council or the City Corporation. He thought the Companies were entitled to hear the whole case to be brought against them before being called upon to deal with it. He made these remarks because Mr. Littler, who represented the Corporation, was not prepared at that moment to cross-examine the witness; and therefore he (Mr. Pember) would proceed, under protest, to do so on behalf of the Companies.

Witness, in answer to Mr. PEMBER, said there were, in the area proposed to be covered by the Bill, between 80 and 90 Local Authorities,

of whom 13 only had at present given an unqualified support to the Bill; but these were within, not outside the Metropolitan area.

Mr. PEMBER: I do not quite follow the meaning of certain phrases you let drop yesterday. You said: "I think the intention of the Committee, or rather what the Committee had in view, was this—that immediately after the Trust was established, they would make a general inquiry into the whole of the water undertakings. They would serve notice upon one of the Companies, and let them go to arbitration. This case would be thoroughly investigated; and then, before the two years expired, the Trust would better know their position, and what further action to take." Do you mean by this that the result of the first arbitration might make you halt and consider whether you should purchase the others?

Witness said what he meant was that they would know whether it was necessary to go to arbitration with each of the seven other Companies, or enter into a treaty for agreement. One arbitration would settle the main principles at issue between the Trust and the Companies. To have taken the machinery for arbitration provided in the Lands Clauses Consolidation Act would largely increase the expense and the time occupied. Certain general principles would have to be decided upon by each separate body of Arbitrators; and there might be differences of opinion on those main principles, leading to compensation being assessed upon various principles for different Companies. The provisions of the Bill would enable the Arbitrators to exclude from consideration the capital value of the additional revenue arising from the quinquennial revaluation.

I thought that was it. But let me call your attention to something in your Bill on that point. The Arbitrator is to take into consideration every circumstance that may depreciate the value of the property in effect, but not any fact that may enhance the value of the undertaking in future. You provide for the prospective depreciation, but decline to admit the plea of possible enhancement?—Yes.

And you think that fair?—Yes; I do not think there is anything to object to in it.

I also notice that you said the Arbitrators "would be appointed under, and would act under, a sense of very deep responsibility, because the issue at stake would be very large. Then they would make the declaration of the Lands Clauses Consolidation Act;" and you added: "Of course, they would always have public opinion before them ready to criticize any award they might make." What do you mean by that?—They would be bound to regard the opinion of the public as to the value of the undertakings. They would make their award in view of the fact that they would have to justify it to public opinion.

Supposing the Arbitrators, sitting to hear the evidence before them, came to the conclusion that the real value of these undertakings was £50,000,000, do you mean to say that they ought to give less than this sum on account of what you call "public opinion?"—Not if it is the real value.

Mr. PEMBER expressed his inability to see what the witness meant by "public opinion." Addressing the Committee, he said he took it that they considered a Water Trust, in some form or another, was a foregone conclusion; and though the Water Companies objected to the Bill, and would be glad to be left alone, he would proceed to discuss the details of the measure with a view to its being made as perfect as possible—thus carrying out, in their own mind, the conclusion at which the Committee had arrived.

In further cross-examination, witness said it was not intended that stock bearing 3½ per cent. interest should, under clause 14, be forcibly converted into Water Trust stock bearing 3 per cent. interest. He should think that, having regard to the triple security given by the Trust, the bulk of the shareholders would take the stock; but if they did not, the Trust would have to go to the market for the capital.

Mr. PEMBER: Supposing there were trying times for money at the moment when you had to pay a large amount on these awards, and supposing that money was "tight," and you had to find several millions of cash, what would happen then?

Witness: We should have to take our chance of that, the same as other borrowing bodies.

I should not mind if only you had to "take your chance;" but I have to take it also. It would matter to me very much indeed if the Trust could not raise the money.—They would be bound to do it.

Mr. PEMBER: Many of us are "bound to do" a great many things that we cannot do.

Cross-examination continued: There was no provision in the Bill for the preference shareholders and debenture holders having the option of taking cash; but they would have the same rights against the Water Trust as they would against the individual undertakings of the Company. He did not think that it was necessary that separate accounts should be kept in respect of each Company, and that the earnings should be hypothecated to the respective debenture and preference shareholders in the several Companies.

Mr. PEMBER: With regard to the compensation to the officers and servants, turning to section 36, we will take the Engineers and Secretaries as two specimens of the eight different Companies. Without mentioning any names, I have a couple of instances before me. There is Mr. A., the Engineer of one of the principal Water Companies, who was appointed nine years ago at the age of 33, and gave up an appointment in the country to take this one in London, thinking it would be permanent. He is now 42. What do you think his chances are of being permanently employed elsewhere?

Witness: I should have no objection to insert a special provision to meet such cases.

I want to know if you think it a fair thing, supposing he had £600 a year, and had been in possession of it for nine years (under your clause 36 he would get half his salary *minus* a sixtieth for all the years he had served under 18), that such a gentleman as that would only get £210 a year? I can give you another case. Supposing a gentleman at the age of 52 was appointed to an equally good situation as Secretary, had been eight years Secretary, and was now 60 years old, do you thing it would be fair to turn him adrift at somewhat less compensation than that, as he would not be likely to get another place?—Special cases like that might fairly be met by a provision in the Bill. If engaged by the Water Trust, and subsequently dismissed, he would be entitled to compensation if he had been of good conduct.

In further cross-examination, witness said he thought he could show a precedent for compulsorily winding up a company whose property was forcibly taken from them, and made to pay all the expenses attending their own dissolution.

Mr. PEMBER: Then perhaps you will try; but we shall understand that if you do not give us one you cannot do so.

Cross-examined by Mr. LITTLER (for the Corporation of London): The powers of the Bill would not enable the Trust to spend any amount of money on purchasing land and building reservoirs, or anything beyond providing for the purchase of the water undertakings and for half a million of working capital. During the last 14 years there had been about 40 Water Bills before Parliament; but he was not aware of any which provided for the construction of new works or the improvement of the existing supply without defining the works to be carried out, or to get water from new and independent sources without specifying the sources.

Replying to Mr. BALFOUR BROWNE (for the Provincial Water Company's Association), witness said they had not absolutely followed the report of Sir W. Harcourt's Committee, but thought they had improved upon that Committee's recommendations.

Witness was re-examined at some length by Mr. RICKARDS, particularly with regard to the steps that had been taken in communicating with the various Local Authorities, and especially with the London County Council, as to their proceedings in connection with the Bill.

In reply to Mr. BOLTON, witness said there was no provision in the Bill that the ratepayers who ran the risk of having to meet any deficiency in the water revenue should have any return for that risk in the shape of a decrease in the municipal burdens if there was an excess of revenue; but practically the ratepayers were consumers of water, and they would get an advantage in the reduction of water-rates. In the case of some of the corporations who were entrusted with the supply of water, but not in all, excess of income went in relief of municipal burdens. In Glasgow they had reduced the water-rates from 1s. to something like 6d. per 1000 gallons. There was this distinction between the present Bill and General Water Bills, that all municipal corporations took power to charge on all the rateable property throughout the area of supply.

Mr. LAWSON: Do you know if, in any Water Act obtained by municipal authorities, there is a limitation of their powers by distributing the profit or income arising from the supply of water either in the reduction of the water-rent or of the general rates?

Witness: I think it goes in both directions.

Fifth Day—Thursday, May 7.

Mr. *Wilkins* was recalled this morning, and put in some tabulated statistics in reference to a number of provincial towns where the waterworks have passed into the hands of the municipal body. These tables had been compiled expressly for the Committee's use from particulars supplied to him by the Engineers of sixteen boroughs; and they were accompanied by a large amount of general information on the Metropolitan Water Question, embodied in a "Memorandum" which was fully noticed in the JOURNAL for Feb. 17 last (p. 310). In answer to Mr. RICKARDS, witness said he had also obtained the official returns as to the increase in the rateable value of the Metropolis during the quinquennial period from 1885 to 1890, with reference to which one of the members of the Committee asked some questions on the previous day. In 1885 it was £29,373,733; and in 1896, £31,450,002.

Mr. RICKARDS said that, after the intimation given by the Committee on the first day, he did not propose to call anybody else on behalf of the Executive Committee of the Vestries, who would merely say "ditto" to what Mr. Wilkins had stated, but who had not gone so exhaustively into the question as he had. The same remark would apply to the case of members of Local Boards who differed from them in detail, but agreed on the general principle of the Bill. Since the resolution in favour of the acquisition of the Companies had been passed, some of the Vestries had withdrawn, principally on the question of the expense of the inquiry; and the present position was that, so far as resolutions had been passed, fifteen were for the Bill and eight against it. He did not propose to call any members of the Boards who were in favour of the main principles of the Bill, but who differed in regard to the details—such as the Wandsworth District Board, who did not approve of the constitution of the Board of Arbitration, or of direct representation as a means of constituting the Water Trust, being in favour of the principle of nomination rather than election. He hoped he would not be considered guilty of treating their views with any disrespect if he did not call those members to explain what he considered to be rather minor points of the Bill.

Mr. *J. W. Grover*, C.E., of Westminster, examined by the Hon. A. LYTTELTON, said he had had great experience in the construction of water-works, and was Engineer to the Rickmansworth and Leatherhead Water Companies. The present supply of water to London by the eight Companies was derived partly from springs and partly from flowing rivers. The springs were chiefly those in Kent; and the flowing streams were the Lea and the Thames. Taking the figures of the Official Water Examiner's report for 1889-90, the population supplied at present was 5,581,491; and the number of houses, 753,555. The supply had reached a total of 107 million gallons daily, on an average; but it had reached as high as 186 million gallons a day. Of this amount, the Thames was responsible for 85 million gallons, the Lea for 58¾ millions, and the springs and wells for 23¾ millions. The increase in the number of water consumers each year in the Metropolitan area was 130,000; and in the net water-rental, £36,700. The springs and wells to which he had referred were situated principally in Kent, and also largely alorg the valley of the Lea.

Mr. LYTTELTON: As regards those springs and wells, do you think that much more can be obtained from them than is at present drawn? Take Kent first.

Witness said, as far as the Kent wells were concerned, he thought more water could be drawn from there to a certain extent; and he believed they were now getting something like 17 million gallons from the chalk. Some of the wells were deeper than others; but the water *bonâ fide* came out of the chalk down to a depth of 300 feet. As a practical engineer, he did not think much more water could be drawn from the Kent wells for London than was being drawn at the present

time; and as regards the Lea, nothing more could be abstracted from the running stream. He understood, however, that wells were still being sunk with success in the Lea valley.

As regards the Thames, what amount is drawn from that every day?—On an average, it was 85 million gallons. The maximum draft of all the Companies was close upon 100 million gallons—98 millions, in fact. The maximum permitted by the Thames Conservancy was 130 millions. Up to two years ago it was, he believed, 110 millions. In his opinion, the Companies ought not to be allowed to draw more than 100 millions; and he thought at the present time they were taking quite enough. He was confirmed in this belief by what took place at the inquiry with reference to the Richmond Bridge Bill last year. He was engaged for the Local Authorities of a number of places below Richmond in opposing that Bill. The evidence given in that case showed clearly that the Thames was being drawn upon certainly to the full extent. To increase the supply they would have to go below Richmond; and this would, to a certain degree, affect Richmond.¶

Having regard to that fact, and to what you have stated as to the Lea and the wells in Kent, do you think much more water can be obtained for London from the present sources?—My opinion is that it cannot, from the present sources.

The conclusion you draw from that is that some auxiliary sources of supply are necessary at present—That is so. For the last ten years these auxiliary sources have been a pressing need; and the idea of the late Sir F. Bolton always was that the supply for London should be supplemented. In 1901 the population of the Metropolitan water supply area would be nearly 7,000,000; and to supply this population at the rate of 30 gallons per head per day would require 45 million gallons more than was at present sent out.

Now with regard to the supplemental supply which you advocate, do you think the quality of the present water good?—Oh, yes; very good. The supply to London is splendid.

I suppose the water obtained from the chalk wells is the best that is at present supplied?—We consider that the chalk water, taking it all round, is the best in a variety of ways. It comes from the greatest depth, and therefore cannot be polluted; and it has another advantage in that it comes up at an equable temperature all the year round. [Witness produced, in a bottle, a sample, which he said had never been filtered or allowed to subside, and which came up at an equable temperature of 52° Fahr. winter and summer.]

Mr. LAWSON: What stratum does it come from?

Witness: From chalk flints, 300 feet deep.

I suppose it is similar to the Kent wells?—Yes; they are all of the same kind—the New River well, the Lea, the Ravensbourne, the Wandle, and the Mole. We have this similar formation of chalk with a quantity of flint; and it is in these beds of flints that the water lies and shoots to the top.

Mr. LYTTELTON: London stands, as we all know, on a bed of clay; and when you sink through the clay, you come to the chalk, do you not?

Witness: Yes.

The chalk, I suppose, at certain spots, crops out?—Not in London, but outside—at Deptford on the south, but north it does not crop up until you get to Uxbridge and Rickmansworth. If you sink a well in London, you get to the water in the chalk; but it has to travel so far to the outcrop, that it is a very feeble supply, and runs away. It is a very thin layer of chalk; this thinness being due to the great pressure of the clay. The result is that the water which flows under London goes right away into the tidal estuary, and passes into the sea. [Witness pointed out on the maps the outcrop of the chalk at Rickmansworth and Leatherhead, and produced sections showing the chalk extending from Rickmansworth through Uxbridge to West Drayton.] All this area is very highly charged with water.

Examination continued: They sank their wells down where the London clay ended and the chalk began, at which point they found springs breaking out. Consequently they had this large field of water, and could pump it from Heronsgate, which was higher than the cross on St. Paul's, to London. At Leatherhead it was precisely the same. There they sank their wells at the junction of the chalk with the London clay, and the water sprang up; and they had the benefit of all the rainfalls on the top which were stored in the chalk.

Mr. LYTTELTON: Dealing with Leatherhead, what do you say as to the abundance of supply from the chalk?

Witness: It is very large indeed. Close to the water-works there were actually breaking out springs producing close upon 4 million gallons of water. They were most marvellous springs—one of them rising from a great depth.

Is there more water there than is necessary for the present purposes of the district?—Immensely more. It was because there was such an abundance that they proposed to utilize some of it for London.

Could you give some idea of the quantity?—I can only give my own opinion, which is that, by judiciously sinking wells in the district between Leatherhead and Dorking, very nearly 10 million gallons a day might safely be relied upon. I do not think this is an excessive estimate at all; as there are certainly 4 million gallons now flowing away at Leatherhead.

Mr. LAWSON: Could that quantity of water be obtained with the present pumping-stations.

Witness: Not exactly. I should want two or three more.

Mr. LYTTELTON: Would that supply which you have spoken of be taken mainly from the rivers or from the springs. I mean, would it have the effect of reducing the supply to the rivers?

Witness said his belief was that the rivers would be very little affected by it indeed. It was not river water that they took, nor surface water, but water from the deep chalk.

Examination continued: With regard to the quantity to be expected from the Rickmansworth district, he had formed the opinion, taking the largeness of this basin, which was 234 square miles, that they might safely depend upon getting 20 million gallons—not at the station itself, but at various points along the valley. It had been proposed for 250 years to supply London from Rickmansworth. The first attempt that was made was in 1641, when it was sought to get water from Harefield, close to Rickmansworth, in connection with the New River Company, who took their water from the Lea; and the inhabitants of the west of London were anxious to get water from the Colne in an adjoining basin. Owing, however, to the trouble with Strafford and the civil wars at the time, this scheme fell through. Since then various attempts had been made, in the reign of Queen Anne and at other periods; and in 1798 an Act was passed, in connection with the Grand Junction Canal, for bringing water from Rickmansworth and Hertford to Paddington, which was greatly in need of it. So that Parliament had really sanctioned a precedent for this undertaking. When power was obtained to make the canal, the parties found it to be much more profitable; so they went to Parliament again, and obtained a release from the obligation of carrying out the Act, and abandoned the Rickmansworth undertaking. When Stephenson made the London and North-Western Railway through Watford, he found an enormous supply of water in the chalk; and he started a Company, called the London and Westminster Water Company, with the view of utilizing it for the purposes of London. But the power of the mill-owners and others was so great that the Bill was thrown out. This would have been a most valuable undertaking. The average rainfall of the district was 25 or 26 inches. The river would account for something like 5 inches; and it was a question where all the rest of the water went to. His own opinion was that it passed into the chalk and ran away in subterranean rivers. Stephenson found this out. Of the 25 or 26 inches of rainfall, he proposed to utilize 2¼ inches for the supplemental supply o London; and he did not see that anybody could find fault with it. The existing Acts of the Rickmansworth and Leatherhead Water Companies gave them power to sell any quantity of water in bulk to outside people provided only that they did not prejudice the supply to those within their own districts. After the wells had been sunk at Leatherhead and Rickmansworth, and the water was shown to be there, they were supported by the Vauxhall and Lambeth Water Companies, who regarded them with favour as supplemental supplies for London.

Cross-examined by Mr. FREEMAN (for the London County Council): He was Engineer for five separate Water Companies, but not for any undertaking at present supplying the Metropolis. As to the question of the impurity of the Thames water, he knew that refuse was brought into it from the land; and, in consequence, the intakes of the Water Companies had been removed higher up the river to prevent pollution.

Cross-examined by Mr. BALFOUR BROWNE (for the Thames Conservancy): He had risked some capital in the undertaking of the Rickmansworth Company; but he did not look upon this scheme as a good way of getting some of it back, as he sold his shares last year. The undertaking had not to his knowledge been offered for sale to several of the London Companies. He had often had long talks with the Engineer of the Lambeth Water Company on the question of getting the water from Rickmansworth to London; but, so far as wishing to sell was concerned, the Directors had a strong idea that they did not. They were quite satisfied. He had never heard of the undertaking being offered to the Southwark and Vauxhall Water Company. The Chairman of that Company was also Chairman of the Rickmansworth Company; and they had, he believed, asked several of the proprietors to take up some shares. The whole of the population within the limits of the Rickmansworth supply was about 18,000, for which an allowance of from 350,000 to 400,000 gallons a day was ample. A Mr. Webster had been sinking wells there, and found large quantities of water. The Leatherhead Company was formed in 1883, and had spent £31,000; the population to be supplied being 9739. The contract price was £24,000; and the contractors took £4000 in shares.

Mr. BALFOUR BROWNE: Have you ever offered this undertaking for sale to any of the London Water Companies?

Witness: I have often spoken to Mr. Louttit (the Secretary of the Lambeth Water Company) about it, and tried to induce him to buy it; but without success.

Now you have found somebody not so sharp as Mr. Louttit—the Vestries?—The Vestries are quite capable of forming their own judgment, I should think. There is no provisional agreement with the promoters for the purchase of the undertakings.

Cross-examination continued: In a purely chalk district, it would be the deep springs which would feed the Thames in summer. If by pumping they affected the water that was the summer supply to the Thames, that would be objectionable; but he did not admit that the pumping would affect that supply.

Mr. BALFOUR BROWNE: In a paper that you have written, I see that you say: "It is often stated that wells sunk in the chalk have the effect of extracting water from the river;" and you go on to say: This is true where the district is all chalk." Do you mean that where a district is not all chalk, but where it is covered by impervious clay, you may take water by pumping that would not get into the stream?

Witness: Yes; that is the basis of the whole thing.

Chalk that is supersaturated is as good for water flowing over it as clay, is it not?—Quite. If the chalk is filled with water, every drop of that which falls on the surface must flow into the rivers. The water is not in a state of quiescence in the chalk, but it is travelling all the time.

If it does not travel, you are going to make it do so with your wells, are you not?—Yes.

Further cross-examined by means of sections, witness said that with regard to surface water, and surface water alone, there would be a cone of exhaustion all round the well; and this would, no doubt, affect wells in the immediate vicinity. In a case of this sort, it would extend scarcely any distance, because they simmered out all the top water. They made their well of impervious bricks set in cement, and had iron cylinders, which they drove down 40 feet into the rock. The well was 300 feet deep.

Mr. BALFOUR BROWNE: Do you say that pumping to a depth of 300 feet will not affect the amount of water all over the surface?

Witness: Certainly not.

This water on the chalk you say is travelling for miles towards the sea, and yet it cannot travel down that 300 feet to the bottom of the well. If you take water out from below, would not some other water take its place?—The water comes up with such tremendous force that it lifts the river up bodily. You can stand by the side and in the middle of the cone, and can see it rising and forming a spring.

Then there is some connection between the bed of the river, which is lifted bodily up, as you describe, and the bottom of the well. Now,

if you put down your pump, and pump to that great depth, do you think it will still be raised in this way?—Certainly not.

Therefore, water which would be raised up and flow into the river will be stopped by your pumping?—Not at this spot, certainly.

Are there not springs breaking out in the river just above where you pump?—There are springs all over.

Do you mean to tell the Committee that you will not affect those springs by pumping 20 or 30 million gallons of water?—I do not think it will affect them at all. I have had to sink a well, 300 feet deep, for the great paper mills, on the direct line from Watford and our pumping station; and no doubt a very vast volume of water is taken by those mills. I certainly was under the impression that, if anything could show the effect of our working, it would be this. I had a series of careful observations made as to the effect upon our wells, and found that it had none.

I have given you a good opportunity of explaining your theory; but have you ever found anybody to agree with you that you can pump from the chalk without producing any effect upon the river? Your paper was read and discussed. Did Dr. Evans combat your theory that the water could be taken from the chalk without affecting the river?—It was at my special invitation that Dr. Evans, who is a very old friend, came and discussed the matter. He is a great mineral engineer, and, of course, cannot look at the matter in the same way as do water engineers.

Mr. BALFOUR BROWNE quoted to the witness the view of Dr. Evans, to the effect that, so far as his experience went, the whole of the water that was not carried away by vegetation or evaporation, or underground to the sea, must find its way in natural overflows to the river; and of Mr. Baldwin Latham, that water could not be taken from the ground at any spot without diminishing the flow of rivers. As wells multiplied in a district, the quantity of water diminished; as the pumping increased, the quantity of water in the wells was lowered. He again asked witness if he had found anybody to agree with him.

Witness said that Mr. Baldwin Latham was a very voluminous and able writer; but Mr. Fox, Mr. Bateman's Engineer, supported his theory, which he said was pretty well illustrated at Bushey.

Cross-examination continued: There was no doubt that there would be a small but inappreciable interference with wells in London, because it was spread over such a vast district. It might reduce the level of the wells a foot or a couple of feet. The pumping around London had sent the wells down 40 feet in the last 10 or 12 years, because the water was feeble, as it had so far to travel to the outcrop of the chalk. The London clay ran up over the district about Hertford; but he did not know that after half an hour's pumping at Hoddesdon, from some of the wells of the New River Company, the ditches on the surface became dry. The circumstances there were geologically the same as at Rickmansworth; but, without knowing the facts, he could not answer the question as to what guarantee there would be that the pumping operations at that town would not result in the same way as did the pumping from the New River Company's deep wells.

The inquiry was then adjourned till the following Tuesday, when the Southwark and Vauxhall Water Bill was taken up. This occupied the Committee till Thursday, when the Bill was passed, with amendments; and the Committee adjourned till the 28th inst. These proceedings will be reported next week.

The Property of the Manchester Corporation Gas Department.—It is reported that £1,000,000 is now the amount at which the corporate properties committed to the charge of the Gas Committee of the Manchester Corporation are valued.

Portadown and the Electric Light.—The Town Commissioners of Portadown are at present negotiating with Messrs. J. E. Gordon and Co., of London, respecting the lighting of the town by electricity. The latter propose to supply 18 arc lamps of 1200-candle power and 50 incandescent lamps of 16-candle power each, or a total of about 22,400-candle power, in place of the present lighting by gas, which, they understand, is about equal to 3000-candle power. They are prepared to erect, maintain, and keep burning these lamps during the present lighting season for the sum of £260 per annum, provided that they obtain "sufficient encouragement from private consumers to make the enterprise remunerative." The lighting of the town by gas last year cost £229, including new lamps and wages.

The Proposed Purchase of the Calverley Water Company's Works.—The question of purchasing the property of the Calverley Water Company was again under consideration at the meeting of the Pudsey Local Board yesterday week. It was moved by Mr. Walker that the Board authorize their representatives, in conjunction with those of the Farsley and Calverley Local Boards, to renew their offer of £12,000 for the plant and undertaking of the Company. This having been seconded, Mr. Forrest moved as an amendment that no steps should be taken until a ratepayers' meeting had been held on the subject. This was seconded. An animated discussion followed thereon, which resulted in six members voting for the resolution, and six for the amendment. The Chairman declined to give a casting vote, whereupon the meeting terminated somewhat abruptly.

Evesham Corporation Gas Department.—In moving the adoption of the annual report of the Gas Committee at the meeting of Evesham Town Council last Wednesday, Mr. Lowe stated that during the past year they had made 14,885,000 cubic feet of gas, against 7,082,000 in 1880; so that they had more than doubled their business in ten years. Of the quantity produced, only 2½ per cent. was unaccounted for; and this was very satisfactory considering the age of some of the mains. The revenue account showed the income to be £3373; and £1119 was carried to the profit and loss account. The profit and loss account began with a balance from the previous account of £333; and the profit for the year was £1119, which made a total of £1452. After paying all expenses, they had a balance to go to the next half year of £531. He also alluded to the great benefit the purchase of the gas-works had been to the town. They had had their public lighting free for ten years; and this meant a saving of at least £3000. They were now paying £300 a year for the public lighting; but if a company supplied the gas, it would cost at least £500.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Friday, May 8.

(*Before Mr. Justice* VAUGHAN WILLIAMS.)

Wenham Company, Limited, v. The Champion Gas-Lamp Company, Limited, and Todtenhaupt.

In the JOURNAL last Tuesday, there appeared a report of the case for the plaintiffs in this action. The hearing of the arguments of Counsel and the evidence given on their behalf occupied the previous Thursday and a portion of Friday; the remainder of the latter day being devoted to the case for the defendants, which we now report, together with the reply of the Attorney-General and his Lordship's judgment.

The ATTORNEY-GENERAL, Mr. ASTON, Q.C., Mr. MOULTON, Q.C., and Mr. LEMSON appeared for the plaintiffs; Mr. MORTON DANIEL and Mr. JENKINS for the defendants.

The following evidence was given for the defendants:—

John Hall said he was foreman to the defendant Company. He was furnished with a copy of the article in the *English Mechanic*, and told to make a model from it which he thought would burn. It was the one which had been produced, and was, he believed, exactly in accordance with the article.

Cross-examined by the ATTORNEY-GENERAL: He received his instructions from Mr. Todtenhaupt, the Managing Director of the Company on Monday last. He had for some years been making the defendants' lamps, which had apertures round the circumference for a second current of air. He recognized the document which was given him to make the lamp from; it was a written copy. The defendants' lamps were constructed from a lamp which was made before he was employed there. The written description said nothing about apertures for the second current of air. He put them in to make the lamp burn. He did not put three burners and three separate deflectors, because he could not very well do so.

Re-examined: He had to take what he could to make the lamp. He had nothing from which to make the three burners and deflectors. He had been about 2½ years in the defendants' service; but he had been in the lamp trade for some 20 years, and had been aware for some time that it was necessary to introduce a row of holes round the circumference. Any competent workman would know that. He had himself tried different sized holes, and found that a particular quantity of air was required to make the lamp burn properly.

Mr. *W. Fullford*, examined by Mr. JENKINS, said he was a practical lamp maker, and had been in the trade since 1872. In 1883 he saw at Messrs. Ridsdale's a lamp which was said to be Mr. Clark's patent. It was handed to him by Mr. Thomas to light. [A question put to witness as to its construction was disallowed.] One of the lamps shown to Dr. Hopkinson was produced. It was made by Messrs. Ridsdale, and was used largely on railways before the date of Clark's patent. The air which entered the lamp was formed into two currents, one of which went through the burner. He was acquainted with the system of regenerative lighting, but had not much knowledge of it prior to Mr. Clark's patent. He read the article on the "Hygienic" lamp; and, constructing a lamp in accordance with it, he should not make holes round the rim, though it would have been against his judgment not to do so. It was well known that air must be brought outside the flame if the lamp was to burn properly.

Mr. *F. Ungar* said he had been a lamp manufacturer and dealer since 1858, and was acquainted with most forms of lamp. At the date of Clark's patent the elements of the combination were known; and he should say there was no novelty therein. There was nothing new in the mode of heating the incoming air, nor in a current of air being introduced into the glass round the rim; and he should think there was nothing new in combining the two. In the defendants' lamp there was not the continuation for bringing the heated air on to the upper or inner surface of the flame, as described by Dr. Hopkinson; it was a complete cast chamber. It was a change in construction which he thought would reduce the consumption of gas. There was a wide difference in the burner of the plaintiffs' lamp and that of the defendants'; and he did not think the burner, as shown in plaintiffs' drawing, would act. There was a great difference between nipples and orifices. He agreed in the main with what the scientific witnesses had stated; but there were some points on which he did not agree; and these had not been touched upon. Reading the specification, he should think the end of the continuation was intended to be open.

Cross-examined: In the plaintiffs' model, the air had to travel a longer distance than in the defendants'. There was also an improvement in the defendants', in the bulge in the gas-supply pipe.

His LORDSHIP pointed out that this had been adopted by the plaintiffs.

Cross-examination continued: The casting was also different. The nearest anticipation to the plaintiffs' patent was that of Siemens.

Mr. DANIEL, in addressing the Court for the defendants, began by remarking that the plaintiffs had secured nearly all the available talent at the Bar.

His LORDSHIP observed that this might be an indication of the badness of their case—requiring so much talent to support it.

Mr. DANIEL then went on to submit that a patent, to be supported, must be not only useful but new. At the date of the patent, regenerative lamps were known, and there was nothing done here but the bringing together of known elements to produce a known result. There was no evidence as to what the merit of the combination consisted in. The only suggestion really was that the invention consisted in combining a secondary current of cold air with the heated current led to the upper surface of the flame. This being a combination patent, he submitted that the doctrine of mechanical equivalents did not apply; and that such difficulties as had been pointed out in the defendants' lamp were sufficient to prevent its being an infringement.

Saturday, May 9.

Mr. DANIEL resumed his address this morning. He said the defence came under two heads—first, that the defendants had not infringed the patent; and, secondly, that the patent itself was invalid. He submitted that the perforated diaphragm was essential to the efficient working of the lamp; that it was not described in the specification; and, therefore, it was no infringement to make use of it. Again, as to the burner, the one now used was not that described and shown in the drawings; and the one employed by the defendants was quite different to that described in the patent, and would not have the same effect. In the defendants' lamp, the perforated diaphragm was much larger in diameter, and the burner being only a small button in the centre of it, there was a large flat ring of flame radiating light downwards and only turning upwards at the extreme edge, while in the plaintiffs' specification, the burner extended beyond the diameter of the diaphragm through which the heated air came; and therefore the body of the flame would turn upwards, and have much less lighting effect.

His LORDSHIP remarked that this point was not put to the scientific witnesses for the plaintiffs.

Mr. DANIEL said he had not perhaps pushed the point home; but he had put questions as to the diameter of the burner. A combination patent might be valid, thought the elements were all old, provided the result was new and beneficial, but otherwise it would not; and where the object sought was old and well known, the claim of a patentee would be more narrowly criticized than if the object were new. This was pointed out by Lord Hatherley (when Vice-Chancellor) in the case of *Curtis v. Platt*. Counsel then submitted that plaintiff's patent was invalid, by reason of the anticipations produced. This related to claim 3—the method of supplying heated air to the inner surface of the flame, by causing such air to pass through the chimney in its passage to the flame, substantially as described and represented in figs. 5 and 6 in the specification. This was clearly anticipated by Siemens (as was admitted by the plaintiffs' witnesses, including the inventor himself), and also by the "Hygienic" lamp. The great point which had been dwelt upon by plaintiffs' witnesses, as making the invention successful, was the introduction of the secondary current of cool air; but that was not claimed or described by the patentee. The claim was for the method of getting heated air to the inner surface of flame, not for bringing cool air to the outer surface. It was, in fact, a claim to the regenerative system of lighting, and would, if valid, have been very valuable; but it was clearly anticipated and therefore the patent must fail.

Mr. JENKINS asked leave to add a few words, as a matter of indulgence.

The ATTORNEY-GENERAL said he did not object, if it were not understood as a precedent.

Mr. JENKINS then pressed the objection to claim 3, and cited authorities in support of his contention. He also submitted that claim 4, relating to the perforated continuation of the air tube, was equally bad.

The ATTORNEY-GENERAL, in reply, suggested that some of the points which had been raised, could scarcely have been put forward seriously, having been laid to rest many years ago; and he hoped his Lordship would indicate as he proceeded what points appeared of importance. He much regretted it if he had failed to enlarge sufficiently on the matter in his opening; but he still maintained what he then stated—that, dealt with on proper legal grounds, the case was practically undefended. He did not wish to take any objection on a point of pleading; but he must point out that the defendants had not, in their particulars of objection, raised the question of want of subject-matter, or he could have brought abundance of evidence with regard to it; but it was practically what they were now setting up. He then proceeded to read and comment on the specification, urging that the leading words in claim 3 were "to the inner surface of the flame," and that was entirely a new thing. It was a claim to the particular method there shown, and not to any general principle. Similar observations applied to claim 4. He then went through the alleged anticipations, which, he submitted, would really lead people away from the track. On the question of infringment, there could seriously be no doubt; the two lamps being really identical.

Wednesday, May 13.

His LORDSHIP, in delivering judgment to-day, said: The plaintiffs, as assignees of letters patent taken out by Frank William Clarke for a combination of invention for the improvement of gas-lamps, sue the defendants for infringement. The defendants by their defence have denied the infringement, and have set up under this plea the several anticipations specified in their objections. A further defence was raised at the trial, on the ground that the invention was not of such a meritorious character as to be patentable; and, by consent, this defence is to be treated as raised by them. The provisional specification was filed in July, 1881; a complete specification in December, 1881; an amended specification in December, 1886; and a further amended specification in February, 1888. The patentee sets forth two modifications of his invention, which generally he describes as an invention relating to lamps where heated air is introduced to supply the flame, so as to produce more perfect combustion. In one modification—viz., that described in figs. 1 to 4 in the specification—an inner concentric tube forms the chimney; and the outer tube serves for the inlet of air, which is heated by the products of combustion passing through the inner tube. In the second modification—figs. 5 and 6—the inner concentric tube serves for the air. It is in respect of the second modification that the plaintiffs complain of the infringement. In the description of the arrangement relating to figs. 5 and 6 appearing in the specifications prior to 1888, the following passage occurs: "In this arrangement a ring, or Argand, or other suitable burner or burners may be employed. E is an earthenware or metal continuation of the tube D; such E being perforated, if found desirable, for causing a portion of the heated air to be brought equally to supply the interior surface of the flame." In the amended specification of 1888, the words "an Argand, or other suitable burner" are erased; and the words "a circular burner of the kind shown in the drawing, and marked B" are substituted. The claim of the patentee is, first, for the respective arrangements described in figs. 1 to 4 and 5 and 6. Those are claims 1 and 2. Then he claims for the subordinate integers thirdly and fourthly; and his claim is in the following words: "Thirdly, the method of supplying heated air to the inner surface of the flame by causing such air to pass through the chimney in its passage to the flame, substantially as hereinfore described, and represented in figs. 5 and 6 of the drawings. Fourthly, the employment of a perforated continuation E from the chimney for distributing the heated air over the interior surface of the flame as hereinfore described, and represented in fig. 5 of the accompanying drawing." I will now deal with the defences seriatim. First, has there been an infringement of the combination arrangement—that is, has the combination in substance been taken—had the defendants, though not exactly using the whole combination, taken by slight variation, or mechanical equivalent, the substance of it, so as to produce the same result by practically the same means? Now if I were at liberty to judge of this question by my own senses apart from the scientific evidence, I should say that the defendants had not taken the substance of the patented combination, and merely made colourable differences. I should say that the defendants had made a new combination in principle by the substitution of a new material element or elements, because it seems to me that the patentee, when seeking to apply hot air to the flame (which was nothing new), invented an arrangement for applying the air by means of a tube above the circular burner with more or less horizontal jets of flame; and that, for the purpose of effecting this, he used a burner of a diameter equal to, or larger than, the diameter of the tube. He also supplied the burner with nipples projecting the flames beyond the diameter of the tube; and thus applied the heated air to the inner surface of the flame, which to a very small extent was horizontal. Finding that, by this arrangement, the heated air was supplied almost entirely to the base of the flame, the patentee attempted to attain the more equal distribution of the heated air by perforating holes around the lower portion of the sides of the tube, and thus bringing the heated air to the upper points or tips of the inner surface or tips of flame; whereas the defendants in their lamps used a steatite burner of a very small diameter, with very little shield or shoulder above the perforated hole through which the gas passes into the flame. The result of this is that the downward current of heated air keeps the jets of flame horizontal, or more or less horizontal, until they extend to the full width of the diameter of the tube, and have thus a ball of flame on the whole inner surface, to which the heated air is supplied with an equality and to an extent not obtained by the patented lamp. The difference is so great that, if I were acting on my own opinion, I should doubt very much whether the lamp with the burner described as in the specification ever could be a practical success; whereas the defendants' lamp is one which, as far as I can judge, would produce a most effective light. In fact, the plaintiffs themselves show, by the form of the lamp which they now manufacture, such appreciation of the essential difference between the application of heated air into a burner of the type mentioned in the patent and a burner such as that used by the defendants, by not only using a steatite burner of small diameter, but also by giving the holes at the end of the tube a concave shape, so as to obtain, as nearly as can be, an equal distribution of the heated air. But I do not think I am at liberty to act on my own opinion in this manner—First, because the scientific evidence, speaking of it generally, is wholly and entirely to the contrary effect; that is to say, the scientific evidence is entirely to the effect that there is no material difference between the arrangement appearing in the two lamps. Secondly, because the particular point of difference to which I am referred was never put specifically to the witnesses on either side, and was only developed for the first time by the defendants' Counsel in summing up his case. The fact of the matter is, that however good a case the defendants may have had, they wholly failed to support it by evidence. I hold, therefore, that the defendants have infringed the plaintiffs' patent, and the only remaining question is the validity of the patent. I wish, however, to say, before leaving the question of infringement, that it was suggested on behalf of the defendants that the specification did not disclose a perforated diaphragm at the end of the air-tube. I have no doubt that the drawing at the end of the specification does disclose such a perforated diaphragm. Then, as to the alleged anticipation (as to which part of the case I have had the assistance of an extremely able argument from Mr. Jenkins on behalf of the defendants), I do not think this plea is substantiated. It is not suggested that there has been any anticipation of the patent as an entire combination—that is, of the patent including the ingenious arrangement for a second current wherewith to cool the globe and pass on the air heated by the globe to the flame from underneath. But it is said that the third claim made is anticipated by the Siemens lamp described on p. 60 of the JOURNAL OF GAS LIGHTING of Jan. 13, 1880, and the Siemens patent of 1889. Now there can be no doubt that, if the claim is for supplying air heated by the products of combustion (by means of the arrangement of concentric tubes in the patent lamp) to the flame of a circular burner, this method was anticipated by Siemens. But it is said that the claim is for the application of the heated air to the inner surface of the flame; and that so read it was not anticipated by Siemens. It is plain, however, that this claim could not have been so read before the amendment of 1888, because we find the reference to Argand burners. The plaintiffs cannot support this part of their claim, unless the meaning of the specification is that the air should come down on to the inner surface of the horizontal flame. This could not be the meaning so long as the specification contained a reference to the Argand burner, because in such a burner the air rushes up from beneath to the inside of the cone of flame. I have, however, arrived at the conclusion—though not without considerable doubt—that I may read the claim as I am asked to do by the plaintiffs, and treat the reference to the Argand burner as a mere slip or mistake. I am led to this conclusion by the fact that the specification, which undoubtedly provides for the application to the flame of a downward current of heated air, is wholly inapplicable to anything but a horizontal or partially horizontal flame. Then as to the fourth claim, if this is to be read as a claim for the employment of the perforated continuation from the chimney for distributing the heated air—it is for the employment of perforation for distribution of the air—it has clearly been anticipated, as alleged by the defendants, by Brooman's patent. Nay more, such a matter as the distribution of air by an air-pipe could not, it seems to me, be the subject-matter of a patent at all. But it is said that this is not the claim, and that the claim is for such distribution

over the interior surface of the flame as is described in the specification, and represented in fig. 5 of the drawing. I think this is the true meaning of claim 4; and I find that the objections founded on anticipations fail. I have only now to add that the objection to the subject-matter of the patent—if the defence is amended by including such an objection—also fails, because I think that this arrangement combining old and new elements is an arrangement for arriving at an old result by an improved means, and that the combination as a whole is not only useful, but has meritorious features, obviating difficulties heretofore existing with reference to gas lighting. Under these circumstances, of course, my judgment must be for the plaintiffs.

On the application of Mr. Aston, his Lordship granted a certificate that the validity of the patent had come into question, and an inquiry as to the infringing lamps sold since the date of the amendment in 1888; but he refused to give the plaintiffs costs on the higher scale, as he considered that the necessity for the scientific evidence which had been given was largely due to the unfortunate wording of the plaintiff's specification.

Monday, May 11.

(*Before Mr.* JUSTICE VAUGHAN WILLIAMS.)

Harrison v. The Southwark and Vauxhall Water Company.

This was an action by a gentleman residing at Kingston, and was originally instituted for an injunction to restrain the nuisance caused by the pumping operations of the defendants in carrying out their works at Kingston. Some months ago a motion was brought for an injunction; and the defendants then altered their mode of operation, substituting different pumps, which practically put an end to the annoyance. The plaintiff therefore intimated that he was satisfied, and would not further persevere with the action, if the defendants would pay the costs. This the defendants objected to; contending that there was never any sufficient ground for bringing the action. It was, therefore, brought to trial substantially for the purpose of deciding simply which side should pay the costs. A great deal of evidence was adduced on either side; and at the conclusion of the arguments on Thursday, the 7th inst., his Lordship reserved judgment until this morning.

Mr. LAWSON WALTON, Q.C., and Mr. C. E. M'LAREN appeared for the plaintiff; Mr. FINLAY, Q.C., and Mr. PARKER for the defendants.

His LORDSHIP said his judgment must be for the defendants. He found the following facts: The defendants sunk a shaft in land adjacent to the plaintiff's house, in pursuance of the powers given by the Act of 1886 and the Acts incorporated therewith; and in the execution of these powers, they used certain lift pumps to pump out the land water, which ran into the shaft in increasing quantities as the shaft was being sunk. He found further that the noise arising from the working of the pumps, which had to be kept going night and day, seriously interfered with the comfort of the plaintiff and the other inmates of his house. These pumps were left in use for about three weeks, until the sinking of the shaft arrived at a point at which it was no longer necessary to lower the pumps to any greater depth. Defendants, in sinking the shaft, might have used other pumps, which would have made less noise—viz., a centrifugal pump, known as the Woodford pump, two of which pumps they had, in fact, used in substitution for the lift pumps ever since the sinking of the shaft arrived at the depth he had mentioned. These Woodford pumps, however, were not usually employed in sinking shafts, and were not convenient for the purpose—partly because of the difficulty of lowering and lengthening the pumps, which would involve from time to time the stoppage of the pumps, and would allow the water to rise in the shaft, thus causing a loosening of the earth behind the wooden linings of the shaft, with a consequent risk to the men employed, and increased labour in digging at the bottom of the shaft, by reason of the superincumbent water. These differences and risk could no doubt be overcome by the use of iron rings for lining the shaft, and the use of two Woodford pumps; so that one might always be at work while the other was being lowered or lengthened. This, however, would have involved an increase in the diameter of the shaft, which again would have required great care in order to avoid loosening the foundations of Kingston Bridge, which the works immediately adjoined. He found also that the defendants were guilty of no negligence in sinking the shaft, or in using the lift pumps, which were pumps ordinarily used for such purposes. The defendants in the first instance intended to use lift pumps so long as it might be necessary to use pumps in the shaft at all, which would be for many months at least; and the centrifugal pumps were in fact at work down to the present time. Plaintiff, through his solicitors, began to remonstrate with the defendants as to the noise caused by the pump about Oct. 6, 1890; and the correspondence continued until the 20th of the month, when the plaintiff issued a writ and gave notice of motion for an interim injunction. On Oct. 22, the defendants gave notice of their intention to use centrifugal pumps, instead of the lift pumps. About Oct. 28, this substitution was made; and since then the plaintiff acknowledged that the pumping had caused him no serious annoyance. In his opinion, however, the plaintiff was not entitled to the injunction or the damages he claimed. It was contended on his behalf that, if the noise of the pumping was physically capable of reduction by the use of the Woodford pump, he was entitled to the injunction and damages, and that it was no answer to say that the defendants used reasonable skill and care, and were guilty of no negligence. To his mind, the more reasonable skill and care, and the absence of negligence, was a defence to the action. In the first place, even without special statutory powers, he thought if the defendants had sunk the shaft and done the pumping for any lawful purpose, they would not be responsible for a legal nuisance. It frequently happened that temporary annoyance was caused to adjoining occupiers by the execution of ordinary and lawful works in the demolition of houses or otherwise. But that was not held to be a legal nuisance, or the business of life could not be carried on. This was, of course, on the assumption that reasonable care was employed, and that the annoyance was not of a permanent character. The defendants were, to say the least, in as good a position as private persons; and the obligations upon them were neither more nor less than there would be upon private persons executing similar works. But even assuming that the sinking of a shaft in this manner would be a nuisance if done by a private person, in this case the statute had authorized the construction of the works. There was still, however, a distinction between the works themselves and the manner of their construction. On that point he thought that the Act authorized not only what was absolutely necessary, but what was reasonably necessary. His Lordship, having referred to several authorities on this subject which had been cited in argument, said he gathered the effect of them to be that reasonable care must be used, and all reasonable means employed, to prevent annoyance, but nothing more. Under these circumstances he must give judgment for the defendants, with costs, though he should be very glad if the defendants could see their way not to insist upon their right to costs. They did not give notice to the plaintiff of their intention to abandon the use of the lift pumps as soon as they had sunk the shaft to a sufficient depth, or he could not help thinking the action would never have been commenced. At the same time, he could not make that a ground for depriving the defendants of their costs. Unfortunately, the action had only been tried for the purpose of ascertaining who should pay the costs; and the plaintiff, when he insisted on going on with the action, had full notice that the defendants did not claim to be entitled to use the lift pumps after the shaft had been sunk.

Mr. PARKER said he was instructed to say that his clients would consent to the action being dismissed without costs.

His LORDSHIP said that was a very fair thing to do.

New Water Supply for Morley.—The construction of the waterworks for Morley, from the designs of Mr. C. Gott, C.E., of Bradford, is now in hand. A reservoir is being made at Withens Clough, with a water area of 63 acres and a storeage capacity of 300 million gallons, which is equal to 200 days' consumption of the full supply, in addition to the quantity required for compensation purposes.

Extensions at the Formby Gas-Works.—We learn from the Manager of the Formby Gas Company that, owing to the increasing consumption of gas in the district, and to meet the requirements of next winter, the Directors have resolved to make some additions to their works. A new gasholder, 58 ft. by 20 ft., is to be erected in a cast-iron tank; and in view of further storeage accommodation being required it is to be prepared for telescoping. Additional retorts are also greatly needed; and two beds of sixes are to be put up.

Longton Corporation Gas Department.—At the last meeting of the Longton Town Council, the Gas Committee reported upon the financial results of the working during the half year ending December 31 last. They stated that the receipts from private consumers amounted to £5738; from public lighting to £997; and meter-rental to £337; a total of £7073, as against £6814 in 1889. The amount of gas sent out in the quarter ended March 31 last, was 30,495,100 cubic feet; and in the corresponding period of last year, 27,935,200 cubic feet, an increase of 2,559,900 feet, or 9 per cent.

Gas Cookery Lectures at Leeds.—Miss Peacock, from the Yorkshire School of Cookery, recently delivered two lectures at the Potternewton Recreation Club, Reginald Terrace, Leeds, on cooking by gas. This lady has been specially engaged by the Gas Committee of the Leeds Corporation for the purpose of giving afternoon and evening lectures every Wednesday throughout the present month; visiting a different quarter of the town on each occasion. She had good audiences on the first occasion; and in two discourses, each lasting about an hour, she illustrated the advantages gas-stoves possess over open fires for ordinary operations.

Improvements at the Neath Corporation Gas-Works.—The minutes of the Gas Committee presented at the last monthly meeting of the Neath Town Council, contained a report from the Gas Manager (Mr. R. A. Browning), giving in detail the cost of different renewals and additions required to complete the gas-works, and to meet the increased consumption of gas. They were as follows: Four regenerative furnaces, £998; station meter, £348; exhauster, £80; four new covers for present purifiers, £120—total, £1546. The amount actually necessary for this year for the purposes of capital account was £1430, as follows: Regenerative furnaces (proportion chargeable to capital), £400; station meter, do., £250; exhauster, do., £30; sundry charges, such as tar well, foundations, chimney, &c., £250; ordinary charges, such as new meters, mains, services, public lamps, fittings, &c., £500; total, £1430; balance of authorized capital unraised, £820—making the total £2250. Mr. Browning recommended the Gas Committee to apply for sanction to borrow the whole of the unraised capital—viz., £2250. The recommendation was adopted; and the minutes were passed.

Overhead Electric Lighting Wires in Sheffield.—Major Cardew, R.E., the electrical adviser to the Board of Trade, has inspected the electric lighting installation of the Sheffield Telephone Exchange and Electric Light Company, Limited, and reported to the Board. He states that the extent of overhead wiring is very large—about 4½ miles of wire for the alternating transformer supply, and rather more for the arc lighting circuits. This wiring appeared to be carefully erected, and, except for the fact that the insulating covering is not sufficiently thick and that a few of the spans exceed the maximum length allowed, is generally in accordance with the regulations issued by the Board of Trade. He points out that the air of Sheffield is very highly charged with carbon and the gaseous products of combustion; the carbon making it impossible to maintain a high insulation by means of the insulating supports used for the wire, as these are liable to be coated by a partially conducting layer of soot, and the acid gases probably acting prejudicially on the insulating covering of the wire. He considers that in all cases where the wires are liable to be touched by shop attendants and others ignorant of the possible danger of touching an electric wire, they should be suitably protected, as well as being coated with the highest quality of insulation. The Parliamentary Powers Committee of the Sheffield Town Council have passed a resolution informing the Board of Trade that, in their opinion, it is most desirable that all wires for the supply of electric light should be carried underground instead of overhead.

MISCELLANEOUS NEWS.

THE DISPUTE AT THE COVENTRY CORPORATION GAS-WORKS.

At Tuesday's Meeting of the Coventry City Council, the Chairman of the Gas Committee (Mr. Andrews), on the invitation of Mr. Wormell, made a statement as to the agitation among the gas workers. He said from the figures which were furnished to him by the Gas Manager (Mr. G. Winstanley), they were at the present moment paying £1800 a year more for the same work than they were paying eighteen months ago, and that lately a demand had been sent in for more money. The cry was still "more," and a demand had been made for a permanent increase of wages, which, if conceded, would amount, so far as could be estimated at present, to about £1400 a year more than was now being paid for the same amount of work that was done a year and a half ago for about £3200 less than the sum now asked for. The demand note that was sent was a printed one. Although it did not bear the name of any printer, he might say, it was known that it was printed in Birmingham and not in Coventry; and further that the envelope and the note that accompanied it bore the address of a Birmingham Trades Union. However, he was happy to say that, upon investigation, matters were not quite so serious as they first appeared. A great many men at the gas-works, and especially the older men—some of whom had been employed there half their lives—had repudiated all responsibility and all connection with the demand note. They stated that they had heard nothing about it until it had been forwarded to the Chairman of the Gas Committee, and that they were furnished with a copy of it. The Gas Committee had held two special meetings to consider the matter, with the result that the whole question was unanimously referred to the Chairman and Gas Manager to further investigate; and, if possible, to suggest a satisfactory arrangement, and to report to the next ordinary meeting of the Gas Committee. The Gas Committee would not have a special meeting to further consider the matter. He might here parenthetically remark that the wages at the gas-works were fully equal to those paid in the neighbouring towns of Birmingham, Leicester, and Leamington, or even equal to those paid in London, or so far as could be discovered anywhere else. Pending the investigation and report, and the decision of the Gas Committee, he thought that any further discussion upon the matter would serve no public interest, and might cause serious trouble. He therefore suggested that the question should be left for the present as it stood; and this was acquiesced in by the members.

ELECTRIC LIGHTING FOR LEEDS.

At the recent Quarterly Meeting of the Leeds County Council, it was stated by Alderman Harrison, the Chairman of the Parliamentary Committee, that arrangements had now been made with the Yorkshire House-to-House Electric Lighting Company, which, he believed, were very fair and satisfactory; and he ventured to hope that, within a reasonable time from now, this would result in the town being supplied to a very large degree—at least the centre of it—with the electric light. The terms of the agreement to which the Alderman referred have been published in an article in the *Leeds Express*, from which we have taken the following: Within two years from the date of the Order, mains are to be laid for the supply of electric energy in specified streets, which form what is called the "compulsory area." In addition, the Company can be required, at any time after the expiration of eighteen months from the commencement of the Order, to give a supply in any other street within the borough, if an undertaking be given to purchase electrical energy, for a period of three years, at such price as will pay the Company—not, however, exceeding 20 per cent. upon the actual cost. This applies to the period in which the Company may not have themselves extended their mains beyond the "compulsory area" to all parts of the borough. The system to be adopted is known as the alternating high potential system. There will be one central station, from which the current will be sent out at an energy of about 2000 volts. At various points in the area to be supplied, there will be sub-stations, in which transformers, or converters, will be placed. From these converters, the electric energy will be distributed to houses and shops at 100 volts. All the mains are to be laid underground. The service-wires from the mains into the houses must be provided at the cost of each individual customer or the landlord; and meters will be charged for separately. The maximum price is fixed by the Board of Trade, and cannot exceed 8d. per unit. The Company have agreed with the Corporation to allow discounts on the full number of lamps required, as follows: For 200 hours' consumption, during any quarter, 5 per cent.; 300 hours, 10 per cent.; 400 hours, 15 per cent.; 500 hours, 20 per cent.; 600 hours, 25 per cent.; 700 hours, 27½ per cent.; 800 hours, 30 per cent.; 900 hours, 33⅓ per cent.; and 1000 hours, 35 per cent. These discounts would thus work out: For 500 hours' use per quarter, under 6½d. per unit; for 1000 hours, 5⅓d. per unit. A sliding-scale for sharing profits, after the Company have secured a given percentage as dividend, was also proposed to be adopted. The Board of Trade, however, objected; and in the end it was arranged that, in lieu of this arrangement, the Board should review the prices at the end of the fifth year, instead of waiting for seven years before doing so. "The unit," says the article, "represents about 17 lamps of 16-candle power, each burning one hour; or a total light of 272 candles for one hour. To obtain the same light, about 140 cubic feet of gas of 16-candle power would be required. The electric light ought to be supplied by the Company at an average of 6d. per unit. Gas, for an equivalent amount of light, would cost 4d. If the electric light had been kept in the hands of the Corporation, it could have been supplied at 4d. per unit. This has been proved by the installation in the Leeds Fine Art Gallery. It has been calculated that, for house or shop purposes, a 5-light installation will cost about £7 10s.; a 10-light, £12 10s.; and for 100 lights, about £1 per light. This includes all wires, switches, fuses, lamps, and casing; but not electroliers." As to the terms of purchase by the Corporation, there are three schemes. The Company have agreed to forfeit their rights at the end of 31 years, if required by the Corporation to do so, and to submit to a revision of charges for electric lighting at the end of every seven years—the first period to be reduced to five. If the Corporation give notice to the Company of an intention to purchase at the end of 31 years, the Company must sell their plant at its then value—such value to be ascertained by arbitration. No good-will or compulsory purchase is to be allowed for; and only such works as are suitable for carrying on the undertaking must be valued. One alternative scheme gives the Corporation a right, after the expiration of 21 years, to purchase the plant at its then value, and to pay, in addition, such sum for goodwill as the arbitrator may determine. Another alternative is that the Corporation may, at any time, require the Company to sell the undertaking for such an amount of Leeds Corporation Stock as will produce, by the interest or dividends thereon, a return of 5 per cent. per annum upon the amount properly expended by the Company and chargeable to capital account. If, however, purchased before the expiration of ten years, then the Corporation must pay in addition a sum equal to the aggregate amount of a dividend of 5 per cent. per annum on the capital expenditure, less the aggregate amount of the dividends previously declared by the Company. The article concludes by saying: "No doubt exists that the terms made with the Company are as valuable as could be obtained; and that they will be in a position to carry out the electric lighting of Leeds in a very satisfactory manner. The Company will be an independent branch of the House-to-House Company, started in 1880. Already they have done an enormous amount of work. At Kensington they have erected a station capable of supplying 15,000 lights; at Eastbourne, 8000 lights; Brighton, 10,000; Madrid, 30,000; and orders have been given to the Company for laying down 18,000 lights at Dublin. In this country alone, they have carried out undertakings representing a total value of over half-a-million sterling."

THE LANCASHIRE GAS COAL TRADE.

From Our Own Correspondent.

The Whitsuntide holidays cause so general and so protracted a cessation of operations at the collieries throughout Lancashire, that for the present the coal trade of this district is in an altogether abnormal condition that scarcely affords any really reliable basis as to the actual state of the market. In the Manchester district, the collieries are closed from Monday evening until Tuesday morning in next week; and in other districts there are stoppages for different periods, but extending generally over pretty nearly a full week. In anticipation of these cessations of work, there has necessarily been a good deal of extra buying on the part of merchants and consumers, to get in supplies sufficient to carry them over the holidays; and this has temporarily given a steadiness to prices so far as current sales are concerned. There is, however, very little disposition to buy for anything like forward delivery, owing to the general feeling of uncertainty as to the possible course prices might take in the immediate future. Although there is no doubt that the colliers will resist to the utmost any attempt at reducing their wages, there are evident indications of a weakening tendency in prices; and the settlement of contracts is being held back as long as possible, in the expectation that, by waiting, more favourable terms will be obtainable. For the present, the better qualities of round coal suitable for house-fire purposes remain tolerably firm at late rates, as supplies of these have so far been moving away without difficulty, and colliery proprietors have been unable to put anything of moment down into stock. It is, however, unlikely that, until they have been able to get moderate quantities down on the pit banks (as is usual during the summer months) to meet the increased requirements for the ensuing winter, there will be any attempt to force sales at lower prices. At the pit's mouth, best Wigan only remains steady at about 12s. to 12s. 6d. per ton; second qualities, 10s. 6d. to 11s.; Pemberton 4-feet coals, 10s. to 10s. 6d.; and common house-fire coals, about 9s. to 9s. 6d. per ton. A slackening off in trade and manufacturing requirements is, however, already beginning to make itself felt upon other descriptions of fuel. The commoner qualities of round coal, suitable for iron-making and steam purposes, are beginning to hang upon the market; and for these, lower prices are being taken. For inland sales, steam and forge coals could be bought readily at 8s. to 8s. 6d., and in some instances at as low as 7s. 9d. per ton at the pit's mouth; while for shipment there is no difficulty in bringing good qualities of steam coal delivered at the High Level, Liverpool, or the Garston Docks, at 9s. 6d. to 10s., and as low as 9s. per ton is being taken in some instances. The better qualities of engine fuel are still moving off fairly well. But common sorts are becoming more and more of a drag; and with the unsatisfactory outlook in the chemical industry, there is a prospect of increasing difficulty in disposing of this class of fuel. Burgy averages 7s. to 7s. 6d. per ton; and good qualities of slack, 6s. to 6s. 6d. Common slack, however, can be bought at almost any price, from 4s. to 4s. 6d. per ton; whilst supplies from outside districts are competing here at excessively low figures. This weakening condition of trade is evidently having its effect upon users of gas coal; and although there are a fair number of contracts upon the market, gas companies and corporations, so far, seem to have only settled for very small quantities. Here and there colliery proprietors who have only limited quantities of gas coal to dispose of, have been able to place contracts on the basis of last year's rates; but, generally, buyers of gas coal are holding out for some substantial concession upon the prices they paid last year, and in many cases they are securing concessions of quite 6d. per ton. It is reported that only a portion of the contracts for the Manchester Corporation, which are at present upon the market, have so far been settled; and the tenders of Lancashire coal-owners which have been sent in on the basis of last year's rates have not been accepted, while those who have offered at a very substantial reduction upon the prices obtained last season have only secured comparatively small quantities. It was believed that a considerable portion of the contracts had been placed with Yorkshire coal-owners at rather low figures; but I am informed that the South and West Yorkshire and Derbyshire owners are in

most cases holding very firmly to last year's prices. There are, of course, a number of coal-owners who are very anxious to secure contracts for their gas coal, and are evidently disposed to come in at low figures to obtain them. These low tenders would seem to be accepted by gas companies and corporations, and a settlement for further supplies is being held over until other colliery proprietors are induced to come forward upon similar terms. As further indicating the course of the market, it may be mentioned that some contracts for locomotive fuel have recently been placed at about 1s. per ton below the prices that were paid last year. The price of coke is also another important matter that is just now affecting the market; and for this description of fuel there is a decided downward tendency in prices—buyers not offering more than about 10s. 6d. to 10s. 9d. per ton for the best Yorkshire cokes available for foundry purposes, which are largely used in this district, and which only last year were fetching as much as 25s. per ton at the ovens.

STOCKTON AND MIDDLESBROUGH WATER BOARD.

The Half-Yearly Accounts.

The accounts of the Stockton and Middlesbrough Water Board for the half year ending Feb. 14, 1891, have been presented to the Corporations of Stockton and Middlesbrough and the Local Board of South Stockton. The accounts show the capital expenditure for the half year to have been £28,907; bringing up the total cost of the undertaking to £1,416,072. Of the capital expenditure during the half year, the principal items are as follows: On account of the Hury reservoir, £2343; Blackton reservoir, £16,003; flood water channel, £395; conduit No. 5 (Sadberge to Eston), £6050; and extension of mains, £883. The sums received on capital account during the six months amount to £51,096, bringing the total amount up to £1,432,900; being £16,827 more than the amount expended. The revenue account shows the income to have been £32,992; being an increase of £987 as compared with the preceding half year, and of £2094 as compared with the half year ending Feb. 14, 1890—this increase being principally derived from the supply of water for manufacturing purposes. The expenditure on revenue account amounts to £7954; being an increase of £94 as compared with the preceding half year, and an increase of £1029 as compared with the six months ending Feb. 14, 1890. The balance carried to the net revenue account is £25,038, as compared with £24,144 in the previous half year, and £23,927 in the six months ending Feb. 14, 1891. The net revenue account is debited with several payments on account of alteration of the engines at Broken Scar and other matters, and is credited with the interest allowed by the bank and rents of land in Baldersdale. After being dealt with in this manner, there remains a balance of £43,245, including the sum of £18,782 brought forward from the previous half year, £30,000 has been paid to the Corporations and the Local Board; leaving the sum of £13,245 to be carried forward, on account of which a further sum of £12,000 has been handed over since the accounts were closed. During the past six months the supply of water for trade and manufacturing purposes continued to increase; the average weekly quantity delivered having been 49,537,000 gallons—being an increase of 1,959,000 gallons per week compared with the corresponding period of last year. The application of the Kirkleatham Local Board for the permission of the Local Government Board to purchase the Water Board's mains in Coatham was, after an inquiry, refused; but it is understood that a renewal of the application has been made, which is still under consideration. The various important works in progress for the improvement of the water supply are being pushed forward with as much speed as is consistent with the nature of the work. There is every prospect of the Hury reservoir being filled before the end of the year; and a commencement has been made with the laying of the gravitation main.

The Finances of the Bradford Corporation Water Department.—Some figures relating to the working of the Water Department during the past year were laid before the members at the meeting of the Bradford Town Council last Tuesday. It appeared that the total receipts for the year amounted to £118,741, which sum was made up of water-rents, £114,843; and rents of property and other sources of income £3898. The total payments amounted to £117,994, consisting of salaries and wages, £5976; rents, rates, and taxes, £6359; waste-water department, £1180; Gilstead filter-works, £736; soke and goit, £194; general repairs, £2291; miscellaneous expenses, £2305—amounting altogether to £19,044. To this had to be added for interest and sinking fund £98,949; bringing the total up to £117,994, and leaving a profit of £743.

The Stockton Corporation and their Gas Workers.—A special meeting of the Stockton Trades' Council was held last Wednesday to consider the action of the Corporation with regard to their gas workers. Mr. Green, the President, stated that the petition, asking the Mayor to call a public meeting to discuss the action of the Gas Committee in refusing to receive a deputation of the Trades' Council in connection with the alleged dismissal of Corporation gas workers because they were Unionists, was signed by 789 men; and many other signatures came in after the petition was forwarded to the Mayor. The memorial was acknowledged by the Town Clerk, who said that the matter to which it alluded had already received the closest attention of the Gas Committee, and had been fully explained to the Town Council. Under these circumstances the Mayor felt himself unable to comply with the request to convene a town's meeting to discuss the action of the Gas Committee, who were responsible to the Town Council. The Vice-Chairman (Mr. Smith) suggested that the Trades' Council should convene a public meeting, as the Mayor had refused. Mr. Storey thought that, as conciliatory measures had failed, more aggressive ones should be adopted. A public meeting should be held, and pressure brought to bear on the town councillors who had to retire this year. It was decided, after further discussion, to hold a demonstration, to be followed by a public meeting, to hear addresses on Trades' Union topics, and also to discuss the gas workers' dispute.

THE METROPOLITAN WATER QUESTION.

Concerted Action on the Part of the Corporation of London and the County Council.

The Special Committee on Water Supply and Markets of the London County Council have made the following report, in which a suggestion is thrown out for united action with the Corporation of London on the Metropolitan Water Question:—

It has been represented to us that the Corporation will be disposed to support a proposal for placing the control of the water supply in the hands of a Statutory Committee of the Council, consisting of either 32, 40, or 48 members, on the understanding that one-eighth of the members of the Committee are to be nominated by the Corporation, leaving seven-eighths to be appointed by the Council. We understand it to be also suggested that matters of administrative detail and management should be delegated to this Committee, but that all important questions should be referred for the consideration and decision of the Council. Some further points have been mentioned; but probably the discussion of these and other questions of detail may be safely left to the Committee representing the Corporation and the Council on the water question. We have come to the conclusion that it will be greatly to the public advantage if the Corporation and the Council join hands in the attempt to give to London the control of its water supply; and we think that the heads indicated above form a satisfactory basis for joint action. We recommend—"That the Council do agree to act in concert with the Corporation of London on the water question, on the basis indicated in this report."

The Parliamentary Committee of the Council have had the foregoing report under consideration, and have reported thereon as follows:—

We have had an opportunity of seeing and considering the report of the Special Committee on Water Supply and Markets, and desire to express our general concurrence in its terms, and in the recommendation made. The report, however, does not point out the manner in which effect shall be given to the Committee's recommendation if adopted by the Council; and in order to make this clear, we recommend—"That the Special Sub-Committee of the Parliamentary Committee on the Water Bills be instructed to negotiate and enter into an agreement with the Corporation of the City of London on the following basis: The placing the control of the London water supply in the hands of a Statutory Committee of the Council of moderate size, on the understanding that one-eighth of the members of the Committee are to be nominated by the Corporation, leaving seven-eighths to be appointed by the Council; the details of administration to be left to the Statutory Committee, but all questions of policy, terms of acquisition of the Water Companies' undertakings, charges to consumers, and finance, to be subject to the control of the Council. That the Sub-Committee be authorized to submit, through Counsel, the result of their negotiations to the Select Committee of the House of Commons which is now considering the Water Bills."

The recommendations have been agreed to.

At the meeting of the Court of Common Council last Thursday, the Chairman of the County Purposes Committee (Mr. Rose-Innes) stated that very satisfactory conferences had taken place between them and the London County Council on the question of the water supply, which would form the subject of a report to the Court on a future occasion.

The Water Supply of Lucknow.—The Municipal Committee of Lucknow have been engaged lately in discussing the introduction of a system of water-works similar to that at Agra, Allahabad, and Benares. The artesian well experiment, after an outlay of nearly a lakh of rupees, is to be given up.

The Gas Profits and the General District Rate at Bradford.—According to a statement made at the meeting of the Bradford Town Council last Tuesday, it is proposed this year to appropriate from the gas profits £2500 towards the borough rate, and £10,500 towards the general district rate.

The Birmingham Gas-Fitters' Trade Association have just held their first annual meeting—Mr. Eli Bloor, a member of the Town Council, presiding. The balance-sheet showed an income for the year of £79 7s. 4d., and an expenditure of £22 3s. 2d.; leaving a balance of £57 4s. 2d. The accounts were passed; and the honorary officers were thanked for their services and re-elected.

New Joint-Stock Companies.—The City of Bath Electric Lighting and Engineering Company, Limited, has been started with a capital of £60,000, in 5500 ordinary £10 shares and 50 founders' shares of £100 each, to adopt and carry into effect an agreement made between Henry George Massingham, of the one part, and the City of Bath Electric Lighting and Engineering Company, Limited, of the other part, and to carry on generally the business of an electric light and power company. The Odiham Gas and Coke Company, Limited, has been registered with a capital of £2000 in £10 shares, to manufacture and supply gas to the town of Odiham, in Hampshire.

Proposed Purchase of the Rhyl Water-Works by the Improvement Commissioners.—At a recent meeting of the Rhyl Improvement Commissioners, it was stated, in the minutes of the Sanitary Committee, that it had been resolved to engage Mr. Deacon, C.E., to report upon the question of water supply. In proposing the adoption of the minutes, Mr. Jones remarked that instructions had been given with regard to the supply which would materially improve it for the present season. It would not, however, be all that the town required; and the question occurred to him how were they to get that. It appeared that there were only two courses to take. One was to purchase the works by arbitration (this the Water Company were willing to accept), and to make an appeal to all the districts concerned. It was quite clear the Company could not give the town a sufficient supply without enlarging their reservoir; and they were unable to do that without further capital, which would mean an increased water-rate. Mr. Clews moved that the Sanitary Committee be authorized to appoint a further deputation to meet the Water Company; and this was agreed to.

NOTES FROM SCOTLAND.

From our Edinburgh Correspondent.

EDINBURGH, *Saturday.*

The proposals which have been for some time floating about the Dunfermline Town Council for the acquisition of the local Gas Company's undertaking have come to a rather abrupt end. This was, unless the Directors of the Gas Company were very anxious for a transfer, in the nature of things, because the movement in the Town Council was not a spontaneous one. It arose out of an agitation over the charges for the gas consumed in the public lamps. I have no evidence to show that the gentleman who brought forward the question adopted a tone denunciatory of the Gas Company for the purpose of beating them down in terms; but, whatever were his motives, the effect of his attitude was to make the Directors of the Gas Company stand on the defensive. Accordingly, when a Committee was appointed by the Town Council to seek a conference with the Directors, "with a view to ascertaining on what terms the Company would be prepared to convey their works and undertaking over to the Corporation," the Directors could give but one reply to the overtures of the Committee—viz., that they were prepared to consider the question of disposing of their undertaking to the Town Council, but were of opinion that it was desirable, before entering into a conference, that the Committee should indicate the terms they proposed to submit. This reply was read to the Town Council on Monday, and gave rise to a series of grumbles on the part of the Councillors. The proposal was made that the Committee be empowered to take the advice of a qualified professional man on the general character of the gas-works, with the view of enabling the Committee to report as to the value of the works. The appointment of an expert was disapproved of by some, their objection being that the Gas Company will soon require to remove their works to a new site, and that the electors last November were opposed to the transfer. It was accordingly proposed, as a counter motion, that the Committee be discharged; and this was carried by 13 votes to 7. It is said that the Council could not make an offer without a conference or a report from an expert. The latter is most probably true; but the Gas Company were not asked to allow an expert to report upon their works. Although it is likely they would refuse such an application, the Council, if they were in earnest, should have appointed someone and made the application. They would have got a report which would have been worth while, whether the Gas Company had afforded facilities or not; and then they would not only have been able to discuss the question themselves intelligently, but they could have given information to the electors which would have guided them in determining whether there should be a transfer or not. Meantime, it is a pity to see that the *Dunfermline Journal* of to-day takes the opposite view, and as good as recommends that people should begin making complaints about the quality of the gas, doubtless with the object of continuing the beating-down policy. The co-partnery of the Gas Company expires in November; and we need not be surprised if, when that time comes, there should be a proposal to convert the Company into a permanent limited liability concern with an increased capital, which would make it more costly for the Town Council to acquire.

Can anyone imagine Socialism flourishing in Aberdeen? No one who knows the powerful individualism of its citizens can; yet there, as in every community of any size, there are a few "enlightened" persons who profess to hold a political creed which has been the aspiration of dreamers in all ages, but has never yet found foothold in any quarter of the globe. Without a grievance to expose, Socialists would be unrecognizable from other people, for it is observable that, however much they may preach about equality, few have ever ventured to put their convictions into practice as a matter regulating their daily life. It would be a disappointment to learn that the Aberdeen Socialists do not practise the doctrines they preach, because their doctrines, if put into practice, would lead to the exemplification of ideal employers of labour such as we have never seen. They have found a grievance in connection with the Corporation gas-works; and they convened an open-air meeting of citizens in Castle Street last Saturday evening, to protest against the supposed "maladministration" at the works. A few hundred persons gathered round their platform, and to these they poured forth a strange medley of argument. The burden of their complaints is that 16 men have been dismissed from the gas-works "for no other reason than that they are growing old;" the fact being that these dismissed men have been found to be incapable of working the new stoking machinery. It was also complained that while men were being dismissed, others were required to work 17 hours out of the 24 hours in the gas-works. Resolutions condemning the management of the gas-works were put to the gathering, and passed. Anyone outside the sphere of the Socialistic labour agitator can perceive, from the arguments which were used, a complete justification of Mr. Smith, the Gas Manager, in all that he has done. With regard to the working of overtime, it is just possible that here and there such may have occurred; but if so, the men would be paid for it, and, as a matter of fact, no complaint by the men on that account has been heard of.

The Perth Gas Commission is still flourishing. Mr. T. Whimster reported on Monday night that the output during the year ending April 30 was 94,425,100 cubic feet, an increase upon the previous year of 8,709,000 cubic feet. Last year an increase of 6 million cubic feet was reported. The estimate for the past year was only 80 millions; and the increase is all the more gratifying that it has taken place in face of a rise of 2d. in the price of gas. A very good yield of gas—10,572 cubic feet per ton of coal carbonized—was also reported by Mr. Whimster.

The Dalkeith Gaslight Company have intimated an increase in the price of gas from 4s. to 4s. 7d. per 1000 cubic feet. A reduction of 4d. per 1000 cubic feet was made about two years ago. Some of the Police Commissioners have been for a time considering the advisability of their acquiring the Gas Company's undertaking; and the present increase is likely to accelerate their desires in that direction. The Crieff Gas Company also have intimated an increase in the price of gas from 4s. 7d. to 5s. per 1000 cubic feet.

The Broughty Ferry Police Commissioners have, on the recommendation of Mr. J. M'Crae, Dundee, who recently inspected the Corporation gas-works, resolved to do nothing to the retort-house, condensers, exhauster, and engine in the meantime; but to add two divisions to the length of the scrubber, to place a syphon between the exhauster and purifiers, to erect a new set of purifiers on the centre valve system, to construct a floor for revivifying oxide over the new purifiers, and to overhaul the valves in the works generally.

The report of the Consulting Engineers upon the proposed additional water supply for Edinburgh has been presented, but has not excited the interest in this district which might have been expected. Probably it is too bulky a document to be at once comprehended by the public. I shall deal with it more fully in next week's "Notes."

From our Glasgow Correspondent.

GLASGOW, *Saturday.*

I lately mentioned the fact that Mr. J. M'Gilchrist, Gas Engineer of the Dumbarton Corporation, was to be professionally engaged in the transfer of the Lockerbie Gas Company's works, plant, &c., to the Burgh Commissioners; but I omitted to say that he was to be the Arbiter for the Gas Company, which is the case. I may now state that Mr. R. Mitchell, Engineer for the Edinburgh and Leith Gas Commissioners, has consented to act as Arbiter for the Burgh Commissioners of Lockerbie. At the monthly meeting of that body held last Monday, the Burgh Clerk was instructed to inquire if the Gas Company would desire the purchase price to be paid in cash down or by annuities.

At the last meeting of the Kilmarnock Town Council, the Gas Committee reported that they had opened premises for the sale and hire of gas-cookers, gas-fires, &c., and up to April 29 the total sales and hires had been 176. The great success of the stove business in Kilmarnock is directly traceable to the exhibition of gas cookers, fires, &c., held in that town last month, under the auspices of the Gas Trust, and to the cookery lectures and demonstrations given in connection therewith by Mrs. Thwaites, of Liverpool.

The example set by the Kilmarnock Gas Trust has already begun to be fruitful, for in the town of Galston, which is only a few miles distant, the Gas Company have resolved to have an exhibition of a similar kind for the town and other two smaller towns near—Newmilns and Darvel. The Directors of the Company have entered into arrangements with Messrs. H. Darwin and Co., Limited, of this city, to organize the show. Not only will the firm named exhibit their varied cooking and heating appliances in actual operation, but will also furnish the community with the most practical test of the advantages of gas-stoves by a course of afternoon and evening cookery demonstrations, which are to be given by the lady who discharged a similar function at the Kilmarnock exhibition. The show at Galston is to open on Monday afternoon—the Chief Magistrate of the burgh (Provost Young) in the chair; and it is to remain open for the whole week.

A proposal to hold a similar exhibition in Rothesay was before the Corporation of that town at the monthly meeting of that body held last Monday. A report from the Gas Committee was submitted by the Convener (Bailie Johnston), in which it was stated that application had been made to the Committee by Messrs. R. and A. Main, of Glasgow, for connections and gas supply for an exhibition of gas-cookers which they intended to hold in the town. In the opinion of the Gas Manager, the cost of the connections and gas used would not be more than 20s. or 30s.; and the Gas Committee agreed that they should be given free. The recommendation led to a considerable amount of talk. Bailie Walker led off for the objectors. Referring to a former exhibition of the kind, he stated that the cost for gas and connections had in that case been about £25. There were, however, on that occasion four or five exhibitors. In seconding the motion for the adoption of the minutes, Treasurer Mackinnon said that Messrs. Main were holding similar exhibitions in several towns. Then came Bailie Macbeth, who displayed a spirit of very marked obstructiveness. He said that he did not see what reason they had for encouraging the use of gas-stoves. It would undoubtedly cause an increased use of gas; but they did not want the consumption increased so much as to cause an extension of the gas-works or their removal to another site. There was no advantage, he contended, in increasing the consumption, unless the gas profits were to be regarded as a legitimate source for making necessary improvements. [I suppose he meant town improvements.] This did not seem to be the mind of the Council at present; and if it was simply to return to the consumers, he did not see why they should try to increase the consumption. Dean of Guild M'Alpin followed in a somewhat similar strain. He moved that Messrs. Main should get neither gas nor fittings free. Bailie Walker seconded the amendment. Ex-Provost Thomson moved to the effect that if the amount exceeded £2, Messrs. Main should be charged with the excess—giving them the gas free. Ultimately this was carried.

The price of Scotch warrants in the Glasgow pig-iron market advanced from 47s. 11d. per ton on Monday to 52s. 1d., at which there were buyers at the close yesterday afternoon. Cleveland warrants have fluctuated in price between 39s. 3d. and 40s. 6d. per ton, and hematite iron between 49s. 10½d. and 51s. 9d. per ton. There is now practically no business being done on the market, beyond the buying by the "bears" each day of the iron required to arrange their settlements; and there is as yet no sign of any relief having been afforded.

Although the prices of coal have gone back since the beginning of the month, none of the coal-masters have intimated reductions in the miners' wages. It is probable, however, that a reduction will be attempted next month. There is a fair demand for ell coal at 9s. 6d. per ton at the pit heads; and dross is quoted at 5s. 6d. per ton.

Gas Cookery Lectures at Stoke Newington.—The Gaslight and Coke Company have resumed their gas cookery lectures in this district. During the past fortnight, both afternoon and evening, Mrs. R. Wilkinson has been demonstrating before large audiences at the Assembly Rooms, Stoke Newington, in her usual practical and felicitous manner, the advantages of cooking by means of gas-stoves. The lectures have been under the management of Mr. T. J. Bird, the Company's Divisional Chief Inspector of the northern district, and have been personally superintended by Mr. E. Kevan. That gas-stoves are appreciated by the public is evidenced by the fact that in the northern division of the Company alone 50,000 are out on hire, besides a large number sold. The following firms showed a variety of gas-stoves and apparatus—Messrs. Fletcher, Davis, Sugg, Wright, Main, and Tilley.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *May 16.*

Sulphate of Ammonia.—If not absolutely sluggish, the market displays but few signs of activity; and the business passing may be said to be one entirely from hand to mouth. £11 still remains the spot value; but seeing the limited extent of the transactions, and anticipating the usual stagnation during the Whitsuntide holidays, buyers generally seem to look for lower prices, and expect to be able to complete purchases below £11. Present circumstances do not, however, indicate any appreciable movement from the current range of values. Nitrate, in consequence of heavy arrivals and some pressure to sell, has declined further; but it is a striking fact that while off-coast cargoes are to-day worth only about 8s. 6d. per cwt., business is reported in April-July shipments at 9s. to 9s. 3d., and Sept.-Nov. shipments at 9s. 3d. to 9s. 4½d. Hence sulphate manufacturers, if taking their cue from nitrate, need not by any means view the future gloomily.

LONDON, *May 16.*

Tar Products.—There is a little more life in creosote and tar oils; but all the other products are dull and difficult of sale. Very little new business has transpired during the week; and distillers who have been looking forward to the spring for better prices are forcing products on the market and depressing prices accordingly. The spurt in anthracene which occurred at the commencement of the year has entirely died out; and this article is as flat as ditch-water—colour makers having doubtless filled in their requirements in the meantime, and are withholding from the market. Pitch is moderately steady; but buyers are seeking to cover their wants next season at lower rates. Prices: Tar, 27s. to 31s. Pitch, 34s. Benzol, 90 per cent., 4s. 1d.; 50 per cent., nominal, 3s. Toluol and solvent naphtha, 1s. 6d. Crude naphtha, 1s. 2d. Creosote, 1¼d. Carbolic crystals, 5¾d.; crude, 60's, 1s. 6d. Cresol, 8d. Anthracene, 30 per cent., "A" quality (nominal), 1s. 4d.; "B" quality, 11d.

Sulphate of Ammonia.—This article continues in rather a bad way; and the market appears to be entirely in the hands of buyers. Sales are reported as low as £10 17s. 6d. in the country, to £11 here. There is an unaccountable falling off in the demand, especially for home consumption. Gas liquor may be obtained at from 5s. to 6s., according to position and strength.

Sale of Shares.—During the past week, 36 £5 shares in the Brompton, Chatham, and Rochester Water Company have changed hands a the rate of £14 15s. per share; 24 at £14 12s. 6d. each; and four a £14 7s. 6d. each.

The Oil Lighting at Bromley.—The partial oil lighting at Bromley (Kent) is to be abolished, if the Gas Company will take over the columns free of charge, and supply gas at a uniform rate of £3 10s. 6d. per annum for each lamp required.

Mr. J. M. Steel, who was for many years Manager for Messrs. Sadler and Co., Limited, has accepted a similar appointment with Messrs. Krayer, Back, and Co., who have just commenced business as general chemical and commission merchants.

Messrs. Unsworth and Richmond, Limited, have just concluded a very successful five days' exhibition, with lectures by Miss Geddes, at Burnley. It was opened last Tuesday by Mr. E. W. T. Richmond. Their exhibits were forwarded on several open lorrie, from Colne to Burnley by road, through Nelson; and the novel feature attracted considerable attention on the way. With regard to this towns we learn that the Gas Committee are having a private test made of various kinds of gas-stoves (among others, those of the above-named firm), to be followed by an exhibition from the 2nd to the 5th prox.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 956.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	10 Apl.	10½	Alliance & Dublin 10 p. c.	10	16—17	..	6 3 6
100,000	10	,,	7⅞	Do. 7 p.c	10	11½—12½	..	6 0 0
300,000	100	2 Jan.	5	Australian (Sydney) 5 % Deb.	100	100—108	..	4 12 7
100,000	20	27 Nov.	8	Bahia, Limited	20	13—15	..	10 13 4
200,000	5	13 May.	7½	Bombay, Limited	5	6½—7*	..	5 7 1
40,000	5	,,	7½	Do. New	4	4½—5¾*	..	5 14 1
380,000	Stck.	26 Feb.	12½	Brentford Consolidated	100	217—222	..	5 10 4
125,000	,,	,,	9⅜	Do. New	100	158—163	..	5 13 6
220,000	20	12 Mar	11½	Brighton & Hove Original	20	40—42	..	5 9 6
320,000	20	10 Apl.	11½	British.	20	44—45	..	5 0 0
50,000	10	12 Mar.	11	Bromley, Ordinary 10 p. c.	10	18—20	..	5 10 0
39,000	10	,,	8	Do. 7 p. c.	10	13—15	..	5 6 8
328,750	10	13 Nov.	6	Buenos Ayres (New) Limited	10	10—11	..	5 9 1
200,000	100	2 Jan.	6	Do. 6 p. c. Deb.	100	100—103	..	5 16 7
150,000	20	26 Feb.	8	Cagliari, Limited	20	25—27	..	5 18 6
550,000	Stck.	10 Apl.	13⅜	Commercial, Old Stock	100	260—265	..	5 3 9
130,000	,,	,,	10⅜	Do. New do.	100	198—203	..	5 5 11
130,000	,,	30 Dec.	4⅜	Do. 4½ p. c. Deb. do.	100	121—126	..	3 11 5
557,320	20	30 Dec.	13	Continental Union, Limited	20	49½—50½	..	5 2 11
242,680	20	,,	13	Do. New '69 & '72	14	—	..	—
200,000	20	,,	10	Do. 7 p. c. Perf.	20	37—39	..	5 2 6
75,000	Stck.	25 Mar.	10	Crystal Palace District	100	195—205	..	4 17 7
486,090	10	28 Jan.	4†	European, Limited	10	20—21	..	—
354,060	10	,,	4†	Do. Partly paid	7½	14½—15½	..	—
5,470,630	Stck.	12 Feb.	13	Gaslight & Coke, A, Ordinary	100	240—244	..	5 6 6
100 000	,,	,,	4	Do. B, 4 p. c. max.	100	96—99	..	4 0 10
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	255—260	..	3 16 11
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	120—125	..	4 0 0
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	175—180	..	4 3 4
1,300,000	,,	,,	7	Do. H, 7 p. c. max..	100	160—164	..	4 5 4
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	253—258	..	3 17 6
476,000	,,	—		Do. K, 6 p. c. Prf.	100	152—157	..	3 16 6
1,061,150	,,	12 Dec.	4	Do. 4 p. c. Deb. Stk.	100	113—118	..	3 7 10
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	122—126	..	3 11 5
908,000	,,	,,	6	Do. 6 p. c. do	100	165—170	..	3 10 6
3,800,000	Stck.	13 May.	12	Imperial Continental	100	228-232*	..	5 3 5
75,000	5	12 Dec.	6	Malta & Mediterranean, Ltd.	5	4½—5	..	6 0 0
560,000	100	1 Apl.	5	Met. of Melbourne, 5p. c. Deb.	100	110—112	..	4 9 3
541,920	20	27 Nov.	6½	Monte Video, Limited.	20	19—20	..	6 10 9
150,000	5	27 Nov	10	Oriental, Limited	5	9—9½	..	5 5 3
60,000	5	25 Mar.	7	Ottoman, Limited	5	4—5	..	7 0 0
166,870	10	26 Feb.	2	Pará Limited.	10	3—4	..	—
420,000	100	4 May	6	People's Gas of Chicago—1st Mtg. Bds.	100	92—97	..	6 3 9
500,000	100	1 Dec.	16	2nd Do.	100	93—98	..	6 2 5
150,000	10	28 Apl.	10	San Paulo, Limited	10	15½—16½	..	6 1 2
500,000	Stck.	26 Feb.	15½	South Metropolitan, A Stock	100	282—287	..	5 8 0
1,350,000	,,	,,	14	Do. B do.	100	235—240	..	5 0 0
166,500	,,	,,	13	Do. C do.	100	242—250	..	5 4 0
678,000	,,	30 Dec.	5	Do. 5 p. c. Deb. Stk.	100	141—145	..	3 9 0
60,000	5	12 Mar.	11½	Tottenham & Edm'nton, Orig.	5	11—13 *Ex div.	..	4 8 5
				WATER COMPANIES.				
729,221	Stck.	30 Dec.	10	Chelsea, Ordinary	100	260—270	..	3 14 1
1,720,560	Stck.	10 Apl.	8	East London, Ordinary	100	212—217	..	3 13 9
544,440	,,	30 Dec.	4½	Do. 4½ p. c. Deb. Stk.	100	140—145	..	3 2 0
700,000	50	12 Dec.	9	Grand Junction	50	115—120	..	3 15 6
708,000	Stck.	12 Feb.	10½	Kent	100	265—270	+2½	3 17 10
1,043,800	100	30 Dec.	9⅜	Lambeth, 10 p. c. max.	100	241—246	..	3 17 3
406,200	100	,,	7½	Do. 7½ p. c. max.	100	195—200	..	3 15 0
260,000	Stck.	25 Mar.	4	Do. 4 p. c. Deb. Stk.	100	118—123	..	3 5 0
500,000	100	12 Feb.	12½	New River, New Shares	100	345—355	..	3 8 4
1,000,000	Stck.	28 Jan.	4	Do. 4 p. c. Deb. Stk	100	125—128	..	3 2 6
902,300	Stck.	12 Dec.	7	S'thwk & V'xhall, 10 p. c. max.	100	170—175	..	4 0 0
126,500	100	,,	7	Do. 7½ p. c. do.	100	165—170	..	4 2 4
1,155,066	Stck	12 Dec.	10	West Middlesex.	100	255—265	..	3 15 6

† Interim dividend.

GWYNNE & BEALE'S PATENT GAS EXHAUSTERS AND ENGINES.

Telegrams: "GWYNNEGRAM LONDON." TELEPHONE No. 2698.

GWYNNE & CO.,

HYDRAULIC AND GAS ENGINEERS,

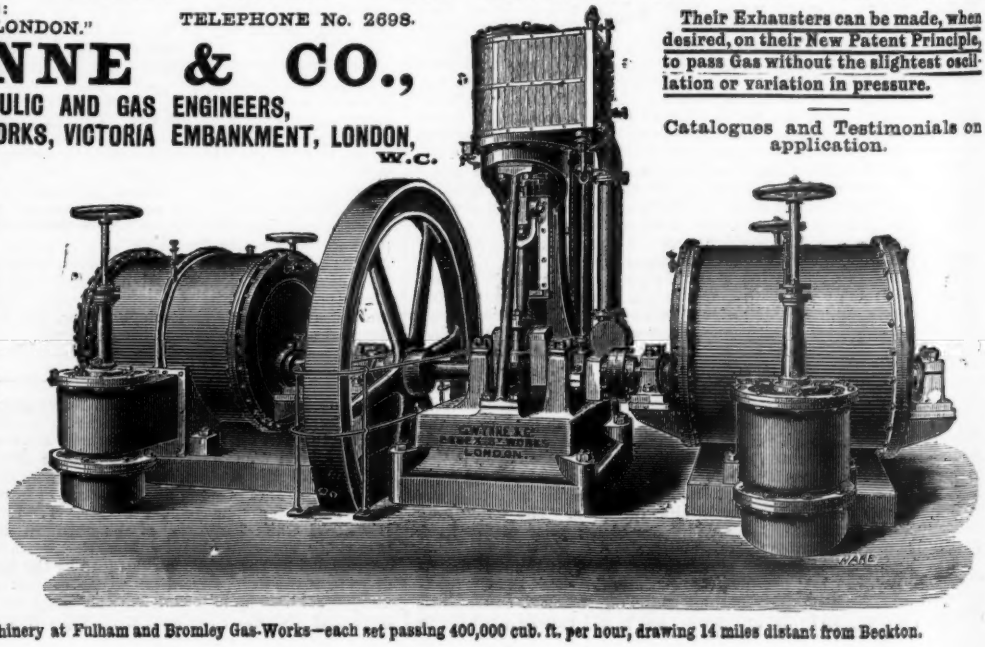
ESSEX STREET WORKS, VICTORIA EMBANKMENT, LONDON, W.C.

Thirty-three Medals at all the Great International Exhibitions have been awarded to GWYNNE & Co. for Gas Exhausters, &c.

They have completed Exhausters to the extent of 29,000,000 cubic feet passed per hour, which are giving unqualified satisfaction in work.

Makers of GAS-VALVES, HYDRAULIC REGULATORS, VACUUM GOVERNORS, STEAM-PUMPS for Tar, Liquor, or Water; CENTRIFUGAL PUMPS and PUMPING ENGINES, specially adapted for Water-Works, raising Sewage, &c.

Also GIRARD and other TURBINES, HIGH-SPEED ENGINES, DYNAMOS, &c., &c., for ELECTRIC LIGHTING.



Their Exhausters can be made, when desired, on their New Patent Principle, to pass Gas without the slightest oscillation or variation in pressure.

Catalogues and Testimonials on application.

Exhausting Machinery at Fulham and Bromley Gas-Works—each set passing 400,000 cub. ft. per hour, drawing 14 miles distant from Beckton.

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides combined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.

Gas Purification and Chemical Company, Limited, Palmerston Buildings, Old Broad Street, London, E.C.

JOHN WM. O'NEILL, Managing Director.

ANDREW STEPHENSON Agent for the GAS PURIFICATION AND CHEMICAL COMPANY, Ltd., Palmerston Buildings, LONDON, E.C.

ANDREW STEPHENSON, Agent for BRIN'S OXYGEN COMPANY, Limited, Westminster, S.W.

City Address: 182, Gresham House, Old Broad Street, LONDON, E.C.

CANNEL COAL, ETC.

JOHN ROMANS & SON, EDINBURGH. Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS AND WATER WORKS.

Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH, / NEWTON GRANGE, NEAR DALKEITH, } SCOTLAND.

SADLER AND CO., LIMITED, MIDDLESBROUGH; ULVERSTON (BARROW); PORTSMOUTH; CARLTON; STOCKTON; 70, Wellington Street, GLASGOW; 58, Fountain Street, MANCHESTER; and 96, Reade Street, NEW YORK. Tar Distillers, Manufacturers of all TAR PRODUCTS, ALIZARINE and other TAR COLOURS, BICHROMES, OXALIC ACID, ALKALIES, LIQUOR AMMONIA, AMMONIA SULPHATE, &c.

Head Office: MIDDLESBROUGH. Correspondence invited.

TAR and Liquor wanted.

BROTHERTON AND CO., Commercial Buildings, LEEDS.

ADVERTISER is open to an Agency for the sale of HOUSE and GAS COALS in North and Mid Wales.

Address, No. 1950, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

COUNTY BOROUGH OF SALFORD.
(GAS DEPARTMENT.)

ANALYST.

THE Gas Committee are prepared to receive APPLICATIONS for the appointment of ANALYST at their Works.

Candidates must have had experience in a Gas-Works, and be able to test Gas for Illuminating Power and Impurities, and make all the Chemical Analyses required.

State age, experience, and salary required, and enclose testimonials from recent employers.

Applications, endorsed "Analyst," and addressed to the Chairman of the Gas Committee, Gas Office, Bloom Street, Salford, to be delivered before Five p.m., on Thursday, the 28th inst.

S. YARRELL SHOUBRIDGE,
Engineer and Manager.

WANTED, a small Second-hand Beale EXHAUSTER.

State full particulars to J. HARDMAN & Co., Tunstall, STOKE-ON-TRENT.

WANTED, a set of Four Second-hand PURIFIERS, 6 feet or 7 feet square, with 6-inch connections; or a set of three 8 feet square.

Price and full particulars to J. MACKENZIE, YARM-ON-TEES.

FOR SALE—A Second-hand 8-inch CENTRE-VALVE with CONNECTIONS, complete and in good condition.

For price, &c., apply to the WATER AND GAS COMPANY, LOWESTOFT.

FOR SALE, very cheap—A second-hand patent ROTARY WASHER, in good condition. Capacity, quarter of a million per diem. Also a STATION GOVERNOR of the same capacity.

For price, &c., either as they stand, or overhauled and put in good working order, apply, by letter, to No. 1937, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

PURIFIERS AND CONDENSER.

WANTED, second-hand, Two Purifiers, in good condition, about 8 ft. by 8 ft.; also CONDENSER, with 6-inch connections (annular preferred), suitable for a small Sulphate Plant.

State price, delivered on rail here, and full particulars to S. BARN, Gas-Works, GODALMING.

JAMES LAWRIE & CO. supply Best SCOTCH CANNEL COALS, Best FIRE-CLAY RETORTS, BRICKS, TILES, and LUMPS; BOILER SEATING BLOCKS, FLUE COVERS, and SILICA BRICKS for SPECIAL FURNACE WORK; COKE BARROWS, BOGIES, and SMALL WAGONS.

Postal Address: 1, WHITTINGTON AVENUE, E.C.
Telegram Address: "EIRWAL LONDON."

W. C. HOLMES & Co., Huddersfield, AND 80, CANNON STREET, LONDON, Contractors for Gas-Works complete, Makers of Gasholders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also for Collingwood's Regenerative Retort-Settings.

*** See Advertisement p. 986 of this week's issue.

Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

J. & J. BRADDOCK, Globe Meter Works, Oldham.

First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.

Telegraphic Address: "Braddock, Oldham."

COZE'S Automatic Apparatus for CHARGING AND DISCHARGING GAS-RETORTS. For Illustrated Advertisement of this System, see p. 861.

Inquiries should be addressed to THE AUTOMATIC COAL-GAS RETORT COMPANY, LIMITED, 86-88A, LEADENHALL STREET, E.C.

RAILWAY Tanks on Hire.

Address BROTHERTON AND CO., Ammonia and Tar Distillers, LEEDS.

WELLINGTON, SOMERSET GAS AND COKE COMPANY.

TENDERS FOR MAINS.

THE Directors of the above Company invite TENDERS for the supply, and laying complete, of about 700 yards of 9-inch MAIN, together with other work.

Copies of specification can be obtained on application to the undersigned; and all tenders must be sent in not later than the 30th of May, and be endorsed "Tender for Mains."

The Directors will not bind themselves to accept the lowest or any tender.

By order,
PHILIP THOMAS, Manager.

BRISTOL UNITED GASLIGHT COMPANY.

TENDERS FOR GAS COALS AND CANNEL.

THE Directors of the above Company are prepared to receive TENDERS for the supply of their requirements (say, 180,000 tons) of GAS COALS during a period of One year, commencing the 1st of July next.

Preference will be given to offers of 20,000 tons and upwards.

Particulars and forms of tender may be obtained on application to the undersigned, to whom also tenders, sealed, and endorsed "Tender for Coal," must be delivered not later than Ten a.m., on Monday, the 15th day of June next.

JAS. V. GREEN,
Secretary.

Gaslight Offices, Canons' Marsh,
Bristol, May 6, 1891.

MERTHYR TYDFIL GAS COMPANY.

TENDERS FOR COAL.

TO COLLIERY PROPRIETORS.

THE Directors of the Merthyr Tydfil Gas Company require TENDERS for the supply over One year of about 5000 tons (or such other quantity as may be agreed upon) of the best quality large well-screened GAS COAL, to be delivered on their Railway Siding (Taff Vale Railway), Gas-Works, Picton Street, Merthyr Tydfil, in such quantities as the Manager may from time to time require during a period commencing on the 1st of July next.

Payments will be made by net cash monthly for previous month's deliveries.

Further particulars, with specification and form of tender, may be obtained on application to the undersigned.

Tenders must be on the Company's printed form, otherwise they will not be considered; and the tender, sealed, and endorsed "Coal," specifying the description of coal, and the pit at which it is to be raised, must be addressed to T. J. Evans, Esq., J.P., the Chairman of the Directors, and delivered at the Gas Offices, Merthyr Tydfil, not later than Ten o'clock a.m. on Tuesday, the 9th of June proximo.

The Directors do not bind themselves to accept the lowest or any tender.

By order of the Board of Directors.
JOHN L. COCKER,
Secretary and Manager.

Gas Offices, Gas-Works,
Merthyr Tydfil, Glamorganshire,
May 13, 1891.

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Chemical Works, LEEDS, specially produce this ACID from BRIMSTONE, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

OXIDE OF IRON.

GENUINE Natural Bog Ore. Quality and condition guaranteed. Any quantity supplied at lowest rates.

D. M. NELSON AND SONS, GLASGOW. Telegraphic Address: "Gas Glasgow." Depôts throughout England and Scotland.

MR. ALFRED KITT, Consulting Engineer, 5, VICTORIA STREET, WESTMINSTER, late Engineer of the Pimlico and Westminster Stations of The Gaslight and Coke Company.

TENDERS FOR TAR.

THE Corporation of Walsall invite TENDERS from Persons willing to purchase the surplus TAR made at their Old and New Gas-Works during One year from the 1st of July next.

The Corporation will deliver it into the Contractor's boats at the Gas-Works. Not more than two boat loads will be allowed to remain in the tanks at each Gas-Works at any time.

The price per quantity of 210 gallons to be stated; to be paid for monthly.

Tenders, sealed, and marked outside "Tender for Tar," are to be sent to me, on or before Saturday, the 30th of May inst.

Security will have to be given for the performance of the contract.

JOHN R. COOPER,
Town Clerk.

Borough Offices, Walsall,
May 14, 1891.

TO LIME MASTERS.

THE Corporation of Walsall invite TENDERS for the supply of about 500 tons of LIME, that will be required at their Gas-Works during One year from the 1st of July next; the deliveries to be in such monthly quantities as the Manager of the Gas-Works may from time to time direct.

The Lime is to be hand-picked and clear from Refuse and Ashes, and to be delivered at Walsall Railway Station, or by boat at Walsall Old or New Gas-Works. In the latter case, it will have to be unloaded.

Payments monthly.

Tenders, sealed and marked outside "Tender for Lime," are to be sent to the undersigned on or before Saturday, the 30th of May inst.

JOHN R. COOPER,
Town Clerk.

Borough Offices, Walsall,
May 14, 1891.

TENDERS FOR GAS COAL.

THE Corporation of Walsall invite TENDERS for the supply of 34,000 tons of STAVELEY, YORKSHIRE, or any other good GAS COAL, to be delivered during One year from the 1st of July next, either at the London and North-Western or Midland Railway Stations at Walsall, or the Corporation Siding at the Pleck Gas-Works, as may be required.

Forms of tender and specification may be obtained on application to the undersigned.

The Corporation do not bind themselves to accept any tender; and they reserve the right to divide the contract between several firms.

Tenders, sealed, and marked outside "Tender for Gas Coal," and stating the price for large Coal and also for Nuts, are to sent to the undersigned on or before Saturday, the 30th of May inst.

JOHN R. COOPER,
Town Clerk.

Borough Offices, Walsall,
May 14, 1891.

TO GAS PLANT MAKERS.

THE Directors of the Formby Gas Company invite TENDERS for the following:—

(1) The supply and erection of a CAST-IRON TANK, 62 ft. by 20 ft. 6 in., and a GASHOLDER, 58 ft. by 20 ft., prepared for Telescoping.

Copy of specification and conditions will be supplied on payment of 10s. 6d.

Drawings to be seen at the Gas-Works on and after Thursday, the 21st inst.

(2) The supply and erection of the necessary RETORT-FITTINGS (Cast and Wrought Iron) for Two Beds of Sixes, including Hydraulic Main.

Copy of specification and conditions will be supplied on payment of 5s.

Tenders to be sent in on or before Wednesday, the 27th of May, endorsed separately, and addressed to the Chairman.

J. W. BUCKLEY,
Engineer and Manager.

Gas-Works, Formby
May 13, 1891.

Price 3s. 6d. post free (76 Pages, Demy 8vo., Limp Cloth),

THE

VALUATION OF GAS-WORKS FOR ASSESSMENT,

By THOMAS NEWBIGGING, M. Inst. C.E.,

With an Appendix containing a Statement of the most Important Cases bearing on the Question, and decided by the Superior Courts. Each of these is preceded by a Digest; and the Judgments are given in full.

Price: Morocco, Gilt, 18s.; Cloth, 15s.; Delivered Free.

THE FIFTH EDITION OF THE

HANDBOOK

FOR

Gas Engineers and Managers,

BY

THOMAS NEWBIGGING, M. Inst. C.E.

LONDON: WALTER KING, 11, BOLT COURT, FLEET STREET, E.C.

TO TAR DISTILLERS AND MANUFACTURING CHEMISTS.

THE Directors of the Wellington (Salop) Coal and Gaslight Company invite TENDERS for the purchase of the surplus TAR to be produced at their Works for One year from the 1st of June next.

Particulars may be obtained from the undersigned, to whom tenders should be sent on or before May 26.

JNO. C. BELTON, Manager.

Gas Office, Market Street, Wellington, Salop, May 6, 1891.

RADCLIFFE AND PILKINGTON GAS COMPANY.

TO TAR DISTILLERS.

THE Directors of this Company invite TENDERS for the purchase of 700 tons of the surplus TAR now in stock and to be produced at their Works in Radcliffe during the ensuing year.

Particulars may be obtained from the undersigned, to whom endorsed tenders must be delivered not later than Thursday, the 4th of June next.

JAMES BRADDOCK, Manager and Secretary.

Gas-Works, Radcliffe, May 14, 1891.

ROCHESTER, CHATHAM, AND STROOD GAS-LIGHT COMPANY.

SUPPLY OF COALS.

THE Directors of the above Company invite TENDERS for the supply of 39,300 tons of GAS COALS to be delivered in the year commencing the 1st of July next, and ending the 30th of June, 1892.

Particulars and copy of form of contract may be had on application to

WILLIAM SYMS, Secretary and Manager.

Gas Office: 58, High Street, Rochester, May 14, 1891.

MIRFIELD GAS COMPANY.

THE Directors of this Company are prepared to receive TENDERS for the surplus TAR and AMMONIACAL LIQUOR produced at the above Company's Works for One year from the 1st day of July next.

For Tar state price per ton at the Works.

For Ammoniacal Liquor state price per ton, per oz. strength from 8 to 12 oz., tested by Wills's Test, delivered either at the Company's Works, or into Contractor's boats.

Tenders to be sent in, endorsed "Tender for Tar and Ammoniacal Liquor," not later than Monday, the 1st day of June, 1891, addressed to

SAMUEL DAY, Secretary.

Gas-Works, Ravensthorpe, *via* Normanton, May 13, 1891.

TO TAR DISTILLERS AND OTHERS.

THE Corporation of Birkenhead invite OFFERS for the purchase and removal of the surplus TAR produced at their Gas-Works, during a period of One year, commencing on the 1st of July, 1891.

Deliveries will be made at the Gas-Works either into Contractor's tanks on the Gas-Works Railway Siding, or into tanks for conveyance by road to boats.

Forms of tender and further particulars may be obtained from the Gas Engineer, Mr. T. O. Paterson, C.E., Gas Works, Thomas Street.

Tenders, sealed, and endorsed "Tender for Tar," to be sent in to me, not later than Five p.m. on Friday, the 22nd of May, 1891.

The Corporation do not bind themselves to accept the highest or any offer.

By order, ALFRED GILL, Town Clerk.

Town Hall, Birkenhead, May 9, 1891.

CORPORATION OF NOTTINGHAM.

(GAS DEPARTMENT.)

TENDERS FOR COAL.

THE Gas Committee are desirous to receive OFFERS for supplies of COALS, COBBLES, or NUTS for the period terminating the 30th of June, 1892.

The large Coals and the Cobbles or Nuts are to be separately delivered, where and as from time to time directed, by and at the expense of the Contractors, upon the Gas-Works Siding, Great Northern Railway, in the East Croft, at Nottingham, and also on the Gas-Works Sidings, Midland Railway, at Radford and Basford respectively; and at and after the rate of one-eighth part of such total quantity in each calendar month, commencing with the month of July next, till the Corporation shall be satisfied with the amount of accumulated Stock, and afterwards at such rate as shall be from time to time directed, till the agreed quantity shall have been delivered.

The Coals, Cobbles, or Nuts are to be the best of their respective kinds, well screened (description, sizes, and inclination of screen to be specified), to be as free as possible from sulphur, bats, bind, refuse, and dirt, and shall be weighed (20 cwt. to the ton) upon the Corporation machines, or upon such other machines as may be mutually agreed upon.

Payments will be made monthly, if and so long as the contract shall be duly fulfilled.

The Corporation do not bind themselves to accept the lowest or any tender.

Further information, and forms on which the tenders must be made, may be obtained on application to me, at the General Manager's Office; and the tenders (sealed), specifying the description of coals, the seam and the pits at which they are to be raised, and stating the prices for deliveries at the several places and in manner and subject to the conditions aforesaid, must be delivered to Samuel George Johnson, Esq., Town Clerk, on or before Monday, the 18th day of May, 1891.

By order, WILLIAM REGINALD CHESTER, Engineer and General Manager.

Corporation Gas Offices, George Street, Nottingham, May 7, 1891.

AMBERGATE, CRICH, ETC., GAS COMPANY.

WANTED, Tenders for Fixing Three sets of new GAS OVENS, Supplementary HYDRAULIC INLET-PIPES, &c., according to plan and specifications to be seen at the Office at the Works, Bull Bridge, near Ambergate.

Tenders to be sent in by the 25th inst., to

JOHN DAWES, Secretary.

Crich, Derby.

IRON ROOF.

THE Directors of the Preston Gas Company are prepared to receive TENDERS for the supply and erection of the IRONWORK, &c., for a ROOF over the Retort-House of their Works, situate in Moor Lane, in Preston.

Plans and specification may be seen at the Office of the undersigned, on and after Wednesday, the 13th inst.

Tenders, addressed to the Chairman, and endorsed "Tender for Roof," must be delivered on or before Wednesday, the 3rd day of June next.

HENRY GREEN, Engineer.

May 4, 1891.

CAMBRIDGE UNIVERSITY AND TOWN GAS-LIGHT COMPANY.

TO TAR DISTILLERS AND OTHERS.

THE Directors of this Company will, at their Meeting on June 4, be prepared to receive TENDERS for the surplus TAR and the whole of the AMMONIACAL LIQUOR produced at these Works, for a period of One year, from July 1 next ensuing.

Further particulars may be had from the undersigned.

WILLIAM DUESBURY, Manager.

Gas-Works, Cambridge, May 5, 1891.

TENDERS FOR THE SUPPLY OF GAS COAL.

THE Widnes Local Board invite Tenders for the supply of about 14,000 tons of GAS COAL (Black "through and through," or screened Coal), to be delivered at the Gas-Works, Widnes.

Conditions and forms of tender may be obtained from Mr. Carr, Gas Engineer, Widnes.

Tenders to be addressed to the Chairman of the Gas Committee, endorsed "Gas Coal," and delivered to the undersigned not later than Eleven a.m., on Monday, the 1st day of June.

The Board do not bind themselves to accept the lowest or any tender.

H. S. OPPENHEIM, Clerk.

Town Hall, Widnes, May 13, 1891.

CROMER, NORFOLK.

TENDERS FOR COAL.

THE Directors of the Cromer Gas and Coke Company, Limited, are prepared to receive TENDERS, from Colliery Proprietors only, for the supply of 800 tons of first-class GAS COAL, to be delivered at (*a*) the Great Eastern Railway Station, or (*b*) the Eastern and Midlands Railway Station, Cromer, between the 1st day of June next, and the 31st day of May, 1892. Weight given to be stated.

Deliveries to be made in such quantities and at such times as may be required by the Company.

Payment, net cash monthly.

Sealed tenders, endorsed "Tender for Coal," to be sent to the undersigned, on or before Monday, the 1st of June next.

The Directors do not bind themselves to accept the lowest or any tender.

By order, P. E. HANSELL, Secretary.

Cromer, May 14, 1891.

CITY OF HEREFORD.

THE Gas Management Committee of the Corporation invite TENDERS for the supply of best screened NORTH WALES GAS COAL for One, Two, or Three years from the 1st of August next, to be delivered free at the Gas-Works Siding, Hereford, in such quantities as may be required from time to time.

The estimated quantity required will be about 6000 tons per annum.

Full particulars and printed forms of tender may be obtained on application to the undersigned.

Tenders, endorsed "Tender for Gas Coal," are to be sent in, addressed to the Chairman, Gas Management Committee, Mansion House, Hereford, by Saturday, May 23.

The Committee do not bind themselves to accept the lowest or any tender.

By order, WILLIAM PARLBY, Gas Engineer and Manager.

Gas-Works, Hereford, May 6, 1891.

CARDIFF GASLIGHT AND COKE COMPANY.

TENDERS FOR COALS.

THE Directors of the above Company are prepared to receive TENDERS for a supply of 50,000 tons of best well-screened large GAS COALS, to be delivered between July, 1891, and the 30th of June, 1892, in monthly quantities, in accordance with the specification.

Parties tendering may do so for the whole quantity or for quantities from 5000 tons upwards.

Forms of tender and specification of monthly deliveries may be obtained on application to Mr. H. Morley, the Company's Engineer.

Sealed tenders to be sent to the undersigned not later than Thursday, the 4th day of June next, addressed to the Chairman of the Company, and endorsed "Tender for Coal."

The Directors do not bind themselves to accept the lowest or any tender, and reserve to themselves the right to apportion the whole quantity as they may think fit.

By order, GEORGE CLARRY, Secretary.

Gas Offices, Cardiff, May 2, 1891.

THE East Dereham Local Board are prepared to receive TENDERS for the supply of about 1200 tons of screened GAS COAL for the ensuing year.

Conditions and forms of tender to be had of the undersigned.

Tenders to be sent in by June 2, 1891.

B. H. VORES, Clerk to the Local Board.

East Dereham, May 13, 1891.

THE Directors of the Farnworth and Kearsley Gas Company are prepared to receive TENDERS for the surplus TAR and AMMONIACAL LIQUOR produced at their Works, together or separately, for One or Two years.

Sealed tenders, addressed to the Chairman, James Warburton, Esq., to be delivered on or before Wednesday, the 27th day of May next.

Forms of tender and any further information required may be obtained from the undersigned.

T. L. SHEPPARD, Manager.

Gas Offices, Farnworth, May 11, 1891.

CANNEL COAL.

THE Bangor Corporation Gas Committee are prepared to receive TENDERS for the supply of 80 to 100 tons of first-class CANNEL, to produce not less than 12,000 cubic feet of Gas per ton.

To be delivered in One or Two lots by Sea on Beach, or in monthly quantities by Railway, during the Twelve months ending June 1, 1892.

Further particulars may be obtained on application to the Manager.

Tenders to be sent in, on or before the 27th inst., to E. Smith Owen, Esq., Gas Office, Bangor.

JOHN SMITH, Manager.

Bangor, May 13, 1891.

TAUNTON GASLIGHT AND COKE COMPANY

TENDERS FOR COAL.

THE Directors are prepared to receive TENDERS for the supply of COAL over One year, commencing the 1st of July next.

Particulars may be obtained of the undersigned, to whom sealed tenders are to be sent on the 1st of June next.

ALFRED EDWARDS, Secretary and Manager.

May 9, 1891.

BLACKPOOL CORPORATION GAS-WORKS.

TENDERS FOR COAL.

THE Gas Committee of the Corporation of Blackpool are prepared to receive TENDERS for the supply of CANNEL and COAL for the next Twelve months from June 1.

Tenders, endorsed outside, to be sent to the Chairman of the Gas Committee, before the 25th day of May.

Forms of tender may be had on application to the undersigned.

JOHN CHEW, Gas Engineer.

Gas Office, Blackpool, May 12, 1891.

GLASGOW CORPORATION GAS.

THE Gas Committee of the Glasgow Corporation invite TENDERS for the supply of such METERS (Dry and Wet) as they may require for Twelve months, from the 1st of June, 1891.

Forms of tender may be had on application to the Manager, at the Gas Office, 45, John Street, Glasgow, and sealed offers, marked "Tender of Meters," to be addressed to, and lodged with, the subscriber on or before Tuesday, the 26th current.

The Committee do not bind themselves to accept the lowest or any offer.

J. D. MARWICK, Town Clerk.

City Chambers, George Square, Glasgow, May 8, 1891.

COUNTY BOROUGH OF SALFORD.

(GAS DEPARTMENT.)

TENDERS FOR COAL AND CANNEL.

THE Gas Committee are prepared to receive TENDERS for the COAL and CANNEL required at their Works during a period of One, Two, or Three years, commencing July 1, 1891.

Forms of tender and conditions of contract may be obtained on application to the Gas Engineer, Gas Offices, Bloom Street, Salford.

Sealed tenders, endorsed "Tender for Coal," and addressed to the Chairman of the Gas Committee, Town Hall, Salford, to be delivered before Five p.m., on Monday, the 25th inst.

S. YARRELL SHOUBRIDGE, Engineer and Manager.

LURGAN GAS, LIGHT, AND CHEMICAL COMPANY LIMITED.

THE Directors are anxious to procure TENDERS for the supply of 2750 tons of best screened GAS COAL, delivered into Lighters *ex* Ship at Belfast, free of all charges.

Delivery of 2000 tons will be taken before the 1st of November next; the remainder to be delivered at such times before the 1st of March, 1892, as may be required.

Vessels carrying from 250 to 350 tons can at once deliver into Lighters, and these Lighters be back for a further cargo within a period to be arranged.

Tenders (in sealed envelope), accompanied by reference to Gas-Works using the Coal offered, should reach me not later than Ten o'clock in the forenoon of Monday, the 1st of June next.

The Directors do not bind themselves to accept the lowest or any tender.

FRED. W. MAGAHAN, Secretary.

Gas-Works, Lurgan, May 5, 1891.

TAR.

THE Directors of the Reading Gas Company invite TENDERS for the purchase of their TAR for One year, commencing on the 1st of July next.

Specifications for the contracts will be forwarded on application. Rail and Water communication direct to the Works.

Tenders, endorsed "Tender for Tar," must be delivered not later than Monday, the 1st of June, to

ARTHUR H. CANE,
Secretary.

Office: 22, Market Place, Reading,
May 12, 1891.

PETERBOROUGH GAS COMPANY.

TENDERS FOR COAL.

THE Directors of the above Company invite TENDERS for the supply of best screened GAS COAL and NUTS for One year, commencing the 1st of July next.

Form of tender and conditions may be obtained on application to the undersigned.

Tenders to be sent in by the 8th of June next, endorsed "Coal," and addressed to the Chairman of the Company.

The Directors do not bind themselves to accept the lowest or any tender.

JOHN BARTON,
Secretary and Manager.

Gas-Works, Peterborough,
May 15, 1891.

TENDERS FOR GAS COAL.

THE Directors of the Burgess Hill and St. John's Common Gas Company, Limited, invite TENDERS for the supply of 400 tons of screened THORNCLIFFE, SILKSTONE, PELAW MAIN, WALLSEND, EAST PONTOP, or other GAS COALS of equal quality, delivered free on rails at Burgess Hill Station (L.B. and S.C.R.), during the second week in June next.

Tenders to be sent to the undersigned on or before the 25th inst.

The Directors do not bind themselves to accept the lowest or any tender.

S. H. NORMAN,
Secretary.

Burgess Hill, Sussex,
May 18, 1891.

TENDERS FOR GAS COAL.

THE Directors of the Romford Gas and Coke Company, Limited, invite TENDERS for the supply of 3000 tons of BEST SOUTH YORKSHIRE SILKSTONE, or other high-class INLAND COAL, during the Twelve months end ng June 30, 1892.

Tenders, endorsed "Tender for Coal," and stating price per ton delivered free at Romford Station, G.E.R., as per schedule to be supplied by the Company, to be sent in on or before May 30, addressed to the Chairman of the Company.

The Directors do not bind themselves to accept the lowest or any tender.

HY. JOHNSON,
Secretary.

South Street, Romford,
May 16, 1891.

COUNTY BOROUGH OF STOCKPORT.
(GAS DEPARTMENT.)

RESIDUAL PRODUCTS FOR SALE.

THE Gas Committee are prepared to receive TENDERS for the purchase of the TAR and AMMONIACAL LIQUOR produced at their Works for a period of One, Two, or Three years, commencing on the 1st of July next. The tenders to state the price per ton for Tar, and price per ton for Liquor (6° Twaddel).

Tenders to be delivered, addressed to the Chairman of the Gas Committee, on or before the 28th of May, 1891, endorsed "Tender for Tar, &c."

Particulars as to quantity and conditions of contract may be obtained on application to the Engineer.

The Gas Committee do not bind themselves to accept the highest or any tender.

WALTER HYDE,
Town Clerk.

Stockport, May 15, 1891.

TENDERS FOR GAS COAL.

THE Directors of the Exmouth Gas Company invite TENDERS for the supply of about 1900 tons of screened or unscreened ARLEY, HOLMSIDE, or NEW PELTON COAL, or best NEWCASTLE or other good GAS COAL.

Tenders to be for price f.o.b.; also price delivered free at Exmouth Docks, between the 1st of July next, and the 30th of June, 1892, accompanied by working analysis.

Sealed tenders, addressed to the Chairman, and endorsed "Tender for Coal," to be sent in not later than the 15th day of June next.

No tender necessarily accepted.

By order,
JAMES T. FOSTER,
Secretary.

Exmouth,
May 14, 1891.

TENDERS FOR GAS COAL AND CANNEL.

THE Directors of the Hebden Bridge Gas Company invite TENDERS for the supply of 4000 tons of good GAS COAL, and 500 tons of CANNEL, delivered free on the Gas-Works Siding, in Gas Company's Waggons, or otherwise, at such times and in such quantities as may be required.

The contract to commence from the 1st day of Sept., 1891, to Aug. 31, 1892.

Tenders, endorsed "Coal or Cannel," to be sent to the Chairman, not later than the 6th of June.

The Directors do not bind themselves to accept the lowest or any tender.

Further information on application to

ARTHUR GRAHAM,
Manager.

Hebden Bridge,
May 15, 1891.

DUNGANNON GAS AND LIGHT COMPANY, LTD.

COAL.

ON Wednesday, the 3rd of June prox., the Directors will consider TENDERS for supplying the Company with 500 tons of best double screened GAS COAL, delivered, free on rail, Belfast, during the month of July.

Board-Room, Dungannon,
May 16, 1891.

TENDERS FOR COAL.

THE Directors of the Derby Gaslight and Coke Company are prepared to receive TENDERS for the supply of 40,000 tons of COAL or NUTS.

Particulars may be obtained from the undersigned.

Sealed tenders, endorsed "Tender for Coal," and addressed to the Chairman of the Finance Committee, must be delivered at the Offices of the Company, Friar Gate, on or before Monday, the 1st day of June next.

RICHARD FISHER,
Secretary.

May 15, 1891.

BOROUGH OF MACCLESFIELD.

THE Gas Committee are prepared to receive TENDERS for the supply of the undermentioned MATERIALS required during a period of Twelve months, commencing the 1st of July, 1891, viz.—

1. Wrought-Iron Lap-welded Steam Tubes and Fittings.
2. The best hand-picked Buxton Lime, delivered fresh at Macclesfield, free from Dirt and Ashes, in such quantities as may be ordered.
3. Cast-Iron Mains and Irregulars.

Forms of tender, &c., may be obtained on application to the Manager, Gas-Works.

Sealed Tenders, properly endorsed, to be addressed to the Chairman, Gas Committee, Town Hall, Macclesfield, and to be sent in not later than Saturday, the 6th of June, 1891.

The Committee do not pledge themselves to accept the lowest or any tender.

(Signed) W. FREDK. TAYLOR,
Town Clerk.

May 12, 1891.

MONTE VIDEO GAS COMPANY, LIMITED.

NOTICE is hereby given, that the NINETEENTH ORDINARY GENERAL MEETING of this Company will be held at the Terminus Hotel, Cannon Street, London, E.C., on Friday, the 29th day of May, 1891, at Twelve o'clock noon, to transact the General Business of the Company.

The Transfer Books will be closed from the 16th to the 29th of May inclusive.

By order,
A. G. HOUNSHAM,
Secretary.

Offices of the Company, Suffolk House,
Laurence Pountney Hill, E.C.,
May 15, 1891.

LEA BRIDGE DISTRICT GAS COMPANY.

BY ORDER OF THE DIRECTORS.

Sale of 600 £10 Shares, part of the further additional share capital authorized by the Lea Bridge Gas Act, 1878, ranking for a dividend of 7 per cent. per annum, subject to usual sliding scale clauses.

MR. ALFRED RICHARDS will Sell the above BY AUCTION, at the Mart, Tokenhouse Yard, E.C., on Thursday, May 28, 1891, at Two o'clock precisely, in lots.

Particulars may be obtained of RICHARD SANDELL, Esq., at the Company's Offices, 3, Jeffrey's Square, St. Mary Axe, E.C., and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

LEA BRIDGE DISTRICT GAS COMPANY.

BY ORDER OF THE DIRECTORS.

Sale of 1000 £10 shares, part of the further additional Share Capital authorized by the Lea Bridge Gas Act, 1878, ranking for a Dividend of 7 per cent. per annum, subject to usual Sliding Scale Clauses.

MR. ALFRED RICHARDS will Sell the above by AUCTION at the Mart, Tokenhouse Yard, E.C., on Monday, June 22, 1891, at One for Two o'clock precisely in lots, instead of May 28, as previously advertised.

Particulars may be obtained of RICHARD SANDELL, Esq., at the Company's Offices, 3, Jeffreys' Square, St. Mary Axe, E.C., and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

TO INVESTORS AND CAPITALISTS.

KETTERING WATER-WORKS COMPANY.

ISSUE OF NEW ORDINARY SHARES AND FIRST MORTGAGE DEBENTURES.

MESSRS. J. ROBINSON AND SON are instructed by the Directors to offer FOR SALE by Public Auction, in Lots, at the Corn Exchange, Kettering, on Friday, June 5, 1891, at Half-past Five for Six o'clock in the evening precisely, pursuant to the provisions of the Kettering Water-Works Act, 1889 (under which all new Shares are to be offered for sale by auction or by tender before being offered to the existing shareholders), 600 NEW ORDINARY SHARES of £10 each in the above Company, part of an additional capital authorized to be raised for the purposes of New Works now in course of construction, and which have been rendered necessary by the constantly increasing demand for the Company's Water, consequent upon the extraordinarily rapid growth of the population and industries of the town.

The Directors also invite APPLICATIONS for £5500 FIRST MORTGAGE DEBENTURES IN BONDS of £100 each, bearing interest at 4 per cent. per annum and redeemable on the 24th of June, 1898.

For information as to the Company's position, and the dividends lately paid on its present capital, with printed particulars and conditions of the present issues, and forms of applications for debentures, apply to the AUCTIONEERS; to MESSRS. G. & H. LAMB AND STRINGER, Solicitors; or to Mr. T. A. SIMPSON, Secretary and Manager, all of KETTERING.

LEAFLETS for Distribution by Gas Companies and Corporation Gas Committees:—

OIL OR GAS FOR LIGHTING OUR HOMES? Price (delivered free) 5s. per 100; £2 per 1000. Larger quantities by agreement. Specimen copy, by post, 1½d.

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THE VALUE OF SULPHATE OF AMMONIA AS A MANURE. By F. J. LLOYD, F.C.S., Consulting Chemist to the British Dairy Farmers Association, Lecturer on Agriculture at King's College, &c. Price 5s. per 100, post free.

THE USE OF SULPHATE OF AMMONIA AS A MANURE. By WILLIAM ARNOLD, Chairman of the Tamworth Gas Company. Price 2s. 6d. per 100, post free.

Published by WALTER KING, 11, Bolt Court, Fleet Street, LONDON, E.C.

Price 2s. per dozen, or 10s. 6d. per 100, post free.

CONSPIRACY and Protection of Pro- perty Act. It is required, under a Penalty of FIVE POUNDS, that a Printed Copy of the 4th Section of this Act shall be posted up at all Gas-Works, in a conspicuous place, where the same may be conveniently read by the persons employed thereat.

Printed copies of this Section, in large type, on broad sheets, may be obtained of WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

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MESSRS. SNOWBALL & Co., Mechanical Valuers, &c., Crown Chambers Side, Newcastle-on-Tyne, have been instructed TO SELL BY PRIVATE TREATY THE ENTIRE STOCK OF ENGINES, &c, belonging to the Estate of the "Beck" Gas-Engine Company, Limited, in liquidation.

The Engines range from 1 to 16 horse power, and are all worth the attention of buyers. There is also a considerable stock of finished parts, from which several complete Engines might be constructed.

N.B.—The British and Foreign Patents are likewise for sale.

MR. W. H. BENNETT having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their Inventions may be secured for Twelve months; or LETTERS PATENT which are granted for Fourteen Years.

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Information as to cost, &c., supplied gratuitously upon application to the Advertiser, 22, Great George Street, WESTMINSTER.

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GAS AND WATER WORKS.

HEBBURN MAIN GAS COALS.

Produce of Gas per ton	10,300 feet.
" Coke "	13½ cwt.
Illuminating Power	16 candles.

For Prices, f. o. b. Ship or delivered, apply to

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Special quotations to Gas Companies.

SOOTHILL WOOD CANNEL.

Yield of Gas per Ton, over 12,000 Cubic Feet.
Illuminating Power - - - - - 26 Candles.
Coke per Ton, - - - - - - - 57 per cent. of a quality almost equal to that made from the best Coking Coal.

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Sole Proprietors of the Largest and Purest Beds of Fire-Clay in England.

FOR GAS FURNACES our GANNISTER and SILICA FIRE-BRICKS are acknowledged to be the best and most durable in the market.

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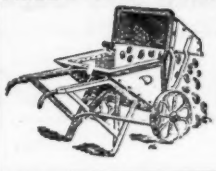
PRICE'S PATENT COKE & COAL BARROW



effecting a great saving of time, labour, and expense.
For particulars, price, &c., apply to Mr. E. PRICE, Inventor and Patentee, 22, Alwyne Road, Canonbury, LONDON, N.

Prices are Reduced.

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ALFRETON IRON-WORKS, DERBYSHIRE,
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PIPES and CONNECTIONS, 1½ to 48 inches in diameter; and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

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"WOODEN CLUSTERS"
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Efficient in action and small driving power.
Patent four-blade exhausters to pass from 50,000 to 500,000 feet per hour.
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EXISTING EXHAUSTERS ALTERED TO PASS AN INCREASE OF 30 TO 50 PER CENT.
Using the same Valves, Connections, and Driving Power.
FRICTION 25 PER CENT. LESS THAN OTHER EXHAUSTERS.
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Model of Four or Three Blade Exhauster on application.
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HUNDREDS OF SETTINGS WORKING EMINENTLY SATISFACTORY.
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Gas Companies are solicited to try Samples of the

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NEWBATTLE CANNEL.

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HOLMSIDE GAS COALS.

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PRESENT production nearly 3000 tons per working day. Area of coal about 5000 acres, including the largest remaining workable proportion of pure HUTTON SEAM GAS COAL. Analysis of HOLMSIDE GAS COAL *in bulk as shipped* gives 10,500 cubic feet of Gas per ton, of an Illuminating Power of 16¼ candles. The Sulphur is about 1 per cent., and the Ash 1¾ per cent. The Coal cokes well, and leaves 69 per cent. of excellent Coke. During the year 1890, the London Gas Companies carbonized about 400,000 tons of HOLMSIDE COALS. They are used by The Gaslight and Coke Company, the South Metropolitan Gas Company, the Woolwich (Government) Gas-Works, the Newcastle and Gateshead Gas Company, the European Gas Company, L'Union des Gaz, and by many other Gas Companies both at Home and Abroad.

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SILICA BLOCKS,

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OF SUPERIOR QUALITY

FOR GAS-FURNACES.

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Strongly recommended where EXCESSIVE HEATS have to be maintained.

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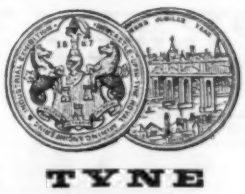

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Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	70 per cent.

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ANALYSIS OF THE ACCOUNTS

OF THE

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CHELSEA, EAST LONDON, GRAND JUNCTION, KENT, LAMBETH, NEW RIVER, SOUTHWARK AND VAUXHALL, AND WEST MIDDLESEX.

Compiled and arranged by ALFRED LASS, *Fellow of the Institute of Chartered Accountants.*

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ALDWARKE MAIN CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.

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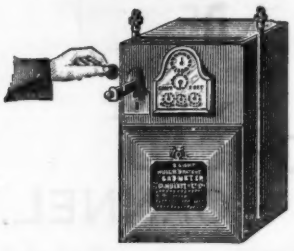
Analysis: 12,600 feet of 19-candle gas per ton.
Weight of illuminating power in pounds of sperm, 820·80. Very free from impurities.
Telegrams: "ATLAS SHEFFIELD."

PREPAYMENT GAS-METER.

(PRICE'S PATENT.)



This Meter has a simple Automatic arrangement fitted, whereby, upon the insertion of a shilling, a supply of gas can be obtained, and which is cut off on the quantity paid for being consumed. The Meter gives warning when the quantity is nearly exhausted, so that another shilling may be inserted. There is, however, no occasion to wait until this happens, as a second shilling can be inserted after two-pennyworth of the first shilling has been consumed.

The Meter is fitted with the ordinary registering dial, and has in addition a circular one divided showing twelve pence. On each Meter is marked the number of cubic feet it will pass for one shilling; and this can be arranged to cover cost of Meter-Rental, Fitting, and Gas consumed. These Meters are made of the best material and workmanship.

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PLANS and SPECIFICATIONS furnished for **Extensions** and **Enlargement** of existing **Works,** adapting them to the most **Improved** and **Modern Principle** of **Gas Manufacture.**

PURIFIERS, CONDENSERS, WASHERS, ENGINES and EXHAUSTERS, STATION METERS and GOVERNORS, manufactured and erected.

Makers, by permission of that eminent authority **Mr. GEORGE LIVESEY,** of his **CELEBRATED PATENT WASHER,** highly approved by all the Engineers of Works where adopted. Largely in demand.

Special reference and attention are invited to our

WET AND DRY METERS,

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Price Lists, Specifications, and Estimates provided for any work appertaining to Gas Lighting, from the Retort-House to the Drawing-Room.

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FOR
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RETORT MOUTH-PIECES,
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PURIFIERS,
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ENGINES,
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&c., &c.

RIVETS
FOR
GASHOLDERS,
BOILERS,
GIRDERS,
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SET SCREWS,
WASHERS,
SPIKES,
AND
FISH PLATE BOLTS.

ESTABLISHED 1825.

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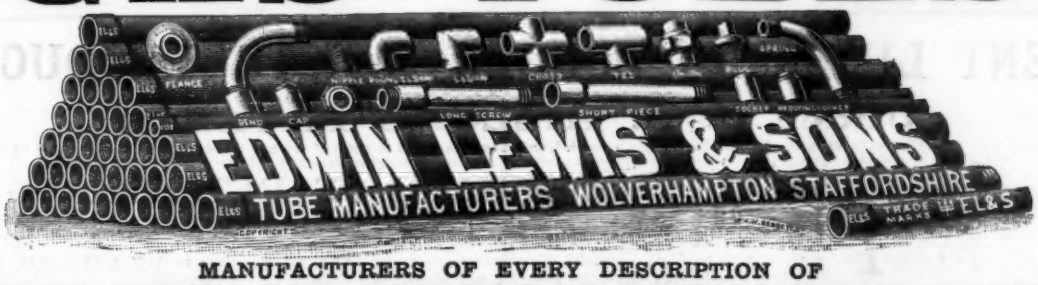

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FOR ANY PURPOSE.

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GOLD MEDAL, PARIS EXHIBITION, 1889.

THE CHIEF ADVANTAGES CLAIMED FOR THIS PROCESS MAY BE SUMMARIZED AS FOLLOWS:—

1. **No skilled labour required.**
2. **Wear and tear of carbonizing tools reduced 50 per cent.**
3. **Great reduction in erection of Ascension-Pipes and Hydraulic Mains.**
4. **Coal carbonized one-sixth quicker than by the old process.**
5. **Absolute control of production by unskilled labour.** (This is most important, especially when there is an extra demand for Gas, as in the case of foggy days, &c.)
6. **Fifty per cent. saving in space of permanent Buildings, thus enabling an old Retort-House fitted by this System to manufacture twice the quantity of Gas.**
7. **This System enables the whole of the old Retorts, Doors, Fittings, &c., to be used (if required) where the Morris and Yan Vestraut's latest improvements are adopted.** (These improvements were described by Mr. Van Vestraut in his Paper read at the last meeting of The Gas Institute. See JOURNAL for July 8, 1890.)
8. **The Morris and Yan Vestraut's System effects a reduction in the cost of carbonizing from 40d. to 10d. (average London prices) per ton of coal, or a saving of more than 70 per cent. in cost of labour.**

This System of Automatically Charging and Discharging Retorts, without machinery or arduous labour, is being largely adopted at the Works of The Gaslight and Coke Co., the South Metropolitan Gas Co., and the Brentford Gas Co., and of several of the Provincial Gas Companies and Corporations.

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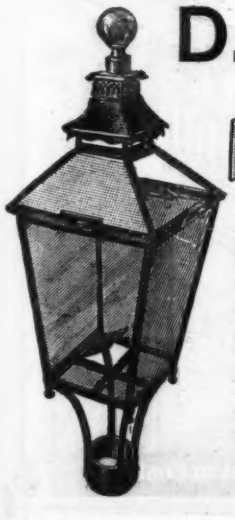
For further particulars apply to W. M. KIGHT, Secretary, AUTOMATIC COAL-GAS RETORT COMPANY, LTD., 86 and 88A, LEADENHALL STREET, LONDON, E.C. (See Illustrated Advt., p. 861.



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No putty required.
Glass secured by hinged clips. No loose parts.
A new pane of glass can be fitted in a few minutes by any inexperienced person.
Glass can be supplied cut ready for use.
The frames are not liable to be damaged as in ordinary lamps when hacking out a broken pane of glass.
The glass can be removed for repainting.
Several thousands of these are now in use, giving general satisfaction.
They are strongly made, and of best material.

"THE METEOR."

NEW HIGH-POWER GAS-LAMP.

Westphal's Patent.

Gas Companies should hire these Lamps to their Consumers, and introduce them for Street Lighting as a rival to the Electric Light, as they do not get out of order, are most economical, and the Burner being a circular slit does not choke up.

Particulars and Prices Free.

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RETORT LIDS

OF ALL FORMS AND SHAPES IN IRON OR STEEL BY SPECIAL HYDRAULIC MACHINERY.

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SPENT LIMES NO LONGER WASTE PRODUCTS.

Under G. R. HISLOP'S PATENTS

All Spent Limes are most effectually, economically, and continuously recovered, and at from one-third to one-half the cost of New Lime. The results are a surprise to all who have inspected the process, and are entirely satisfactory to all now using it. Descriptive Pamphlet and Terms from Agents as under.

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Illustrated Pamphlet and Terms on application to J. E. FISHER, Stourbridge, Agent for England and Wales; to C. M. HAMILTON, Portland Place, Hamilton, Agent for Scotland and Ireland; and for all other Countries to the Patentee,

Geo. R. HISLOP, Gas Engineer, PAISLEY, N.B.

G. J. EVESON,

GAS COAL AND CANNEL CONTRACTOR,

PATENTEE OF

A SPECIAL COMPOUND

FOR THE CURE OF STOPPED ASCENSION-PIPES,

A couple of charges of which will clear a stopped pipe, and an occasional charge keeps them clean, and also increases the make per ton and the illuminating power.

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SIMPLE IN CONSTRUCTION EFFECTIVE IN RESULTS
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OF EVERY DESCRIPTION.

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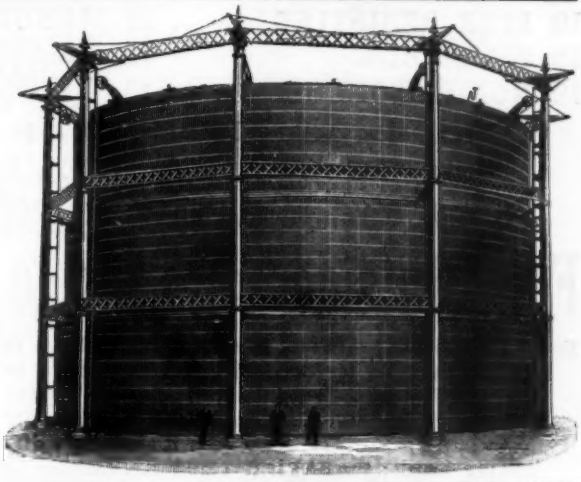

WEST'S GAS IMPROVEMENT Co., Ltd.,

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ALBION IRON-WORKS, MILES PLATTING, MANCHESTER,

MANUFACTURERS OF

WEST'S PATENTED MACHINERY FOR CHARGING AND DRAWING GAS-RETORTS.

OVER 180 MACHINES AT WORK AND IN COURSE OF CONSTRUCTION.

Advantages attending its use are:

INCREASED VOLUME of GAS per TON, and INCREASED YIELD per Retort.—The system of breaking and distributing the coals in an even layer in the retorts effecting more perfect carbonization.

REDUCTION in LABOUR and COST of WORKING.—In Works where this System of charging and drawing Retorts is adopted, there has been effected a substantial saving in the cost of Gas Manufacture in the Retort-House; the amount saved varying in different Gas-Works from **8 PENCE** to **15 PENCE per Ton** of coal carbonized. Full particulars will be forwarded upon application to W. G. I. Company, Limited.

MANUAL CHARGING AND DRAWING MACHINES.

POWER CHARGING AND DRAWING MACHINES, driven by COMPRESSED AIR, STEAM, or ROPE. The power machines are applicable to circular, oval, or Ω-shaped retorts and mouthpieces, and are the most perfect, economical, efficient, and durable machines made. They are constructed on principles founded by long and extensive experience in this special branch of gas engineering and the manufacture of gas.

MAKERS OF COAL BREAKING, ELEVATING, AND CONVEYING MACHINERY, COKE BREAKING AND WASHING MACHINERY.

Sole Makers of CIRCULAR, OVAL, or Ω-shaped MOUTHPIECES with Morton's Self-Sealing Lids, fitted with

KING'S PATENT FASTENINGS,

secure a very tight joint; and at the same time the eccentric motion given to the Lid effectually removes the Tar from the surfaces of the Joint.

N.B.—The whole of these Fittings are made of Wrought Iron. Several Thousands in use.

West's Improved Combined Regulating Liquor Seal Valve.

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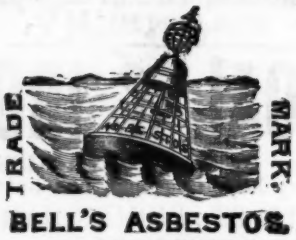
Illustrated Catalogue sent upon application.

Mr. JOHN WEST, M. Inst. C.E., *Managing Director.*

BELL'S ASBESTOS AQUOL PAINT



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IS WASHABLE.
IS NON-POISONOUS.
IS MANUFACTURED IN ALL USEFUL COLOURS.
IS IMPERVIOUS TO HEAT, COLD, OR WATER.
IS WITHOUT SMELL.

No expensive Oil or Turpentine required.

WILL NEVER BLISTER.

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For Outside or Inside Work in any Climate.

Bell's Asbestos Aquol Paint is equally suitable for the finest decorative work as well as for general painting. It can be applied over or under any other paint, and, owing to its easy application, can be used with a large distemper brush; the SAVING THUS EFFECTED IN LABOUR BEING **50** PER CENT. OVER THAT OF LEAD PAINTS.

Bell's Asbestos Aquol Paint is susceptible of the most delicate treatment; and, owing to its perfect flatted surface, it brings up the varnish in a manner that no other paint can equal. ONE COAT OF VARNISH ON **Bell's Asbestos Aquol** IS EQUAL TO TWO COATS ON ORDINARY PAINT.

BELL'S ASBESTOS AQUOL PAINT is specially adapted for Private Houses, Exhibition Buildings, Ships, Churches, Asylums, School Boards, Railway Stations, and all work of Wood, Iron, Cement, Plaster, Stone, Brick, &c., &c.

Those who Study Economy and Protection from Fire should use only

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BELL'S ASBESTOS AQUOL PRIMING is made Ready for Use.
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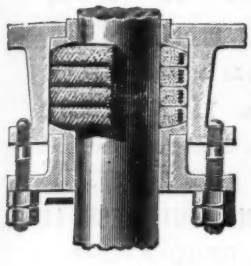
BELL'S ASBESTOS DAGGER PACKING

PATENT No. 15,498.



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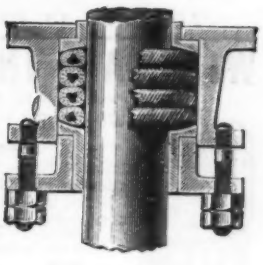

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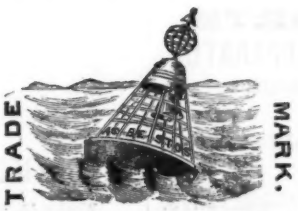

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Is specially suited for Hydraulic Machinery, Accumulators and Ammonia and all Pumps.

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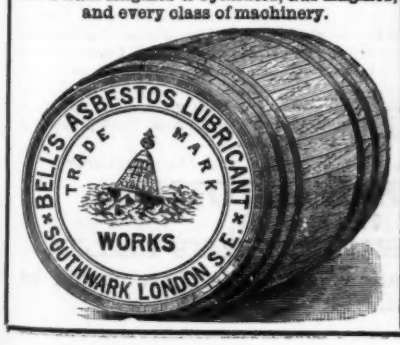
Is unequalled For Steam-Engines & Cylinders, Gas-Engines, and every class of machinery.



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The reputation of this Lubricant is based on the experience of thousands of users, which places it far in advance of those who rely only on mere laboratory tests.

ASBESTOLINE IS THE CHEAPEST MOST EFFICIENT, CLEANEST MOST INODOROUS AND SAFEST LUBRICANT.

ASBESTOLINE HAS SAVED 90 PER CENT. OVER OIL. Has been used for all purposes, AND BEATEN ALL OTHER LUBRICANTS IN ACTUAL WORK.

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Is the most efficient and reliable Material for Manhole, Mudhole, Steam-Pipe, and all other Joints.

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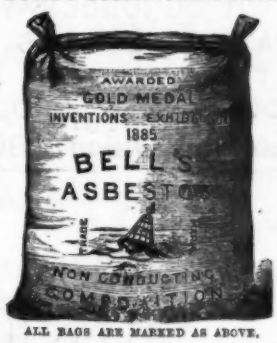
Will reduce loss by radiation and save 40 per cent. of fuel. Is superior to any other, and saves its cost in a few months.



Can be applied again after many years' service. Is sent out dry in bags; therefore cheaper than others sent out wet.

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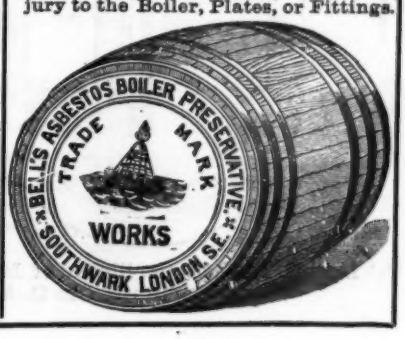
Will effectually keep Boilers clean, and remove any Incrustation, without injury to the Boiler, Plates, or Fittings.



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3. Uniformity in thickness, ensuring equal Expansion and Contraction.

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SUPPLY FROM STOCK

CAST-IRON RETORTS,

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Sole Manufacturers of LYON'S 'PATENT' GAS MAIN SYPHONS.

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GLASS—Flint Opal, and Bent in Stock, and Cut to Sizes.

WELL LAMPS, STREET NAME TABLETS,

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LANTERNS COCKS, REGULATORS,

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PUTTYLESS STREET LAMP.

This Lamp may be supplied fitted with clear opal, or ribbed glass, *as also with enamel tops* if required. The necessary fittings for altering existing Lamps to this system can be supplied at moderate prices.

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PATENT EXHAUSTERS,
PATENT ANTI-DIP PIPES,
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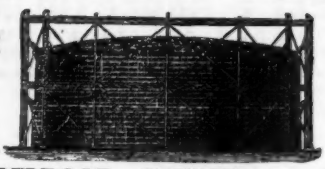

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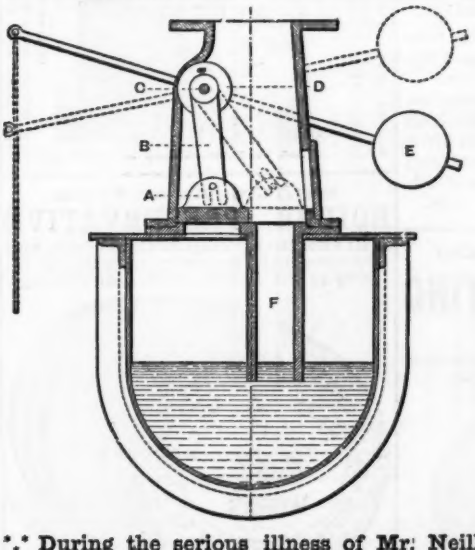

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5, *Norfolk Street, Manchester, Dec.* 11, 1889.

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Further particulars from the Sole Patentee and Manufacturer,

NEILL MEIKLEJOHN,

GAS ENGINEER,

LONGWOOD, HUDDERSFIELD.

*** During the serious illness of Mr. Neill Meiklejohn, all communications as to the above should be addressed to C. Meiklejohn, Gas Engineer, Oldbury, near Birmingham.

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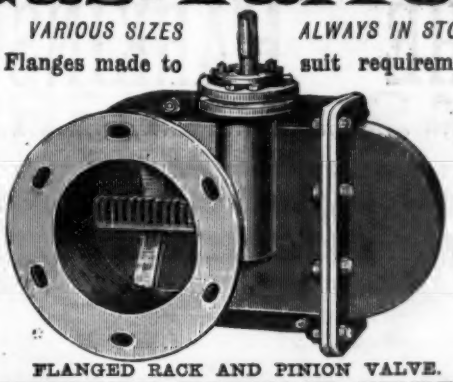

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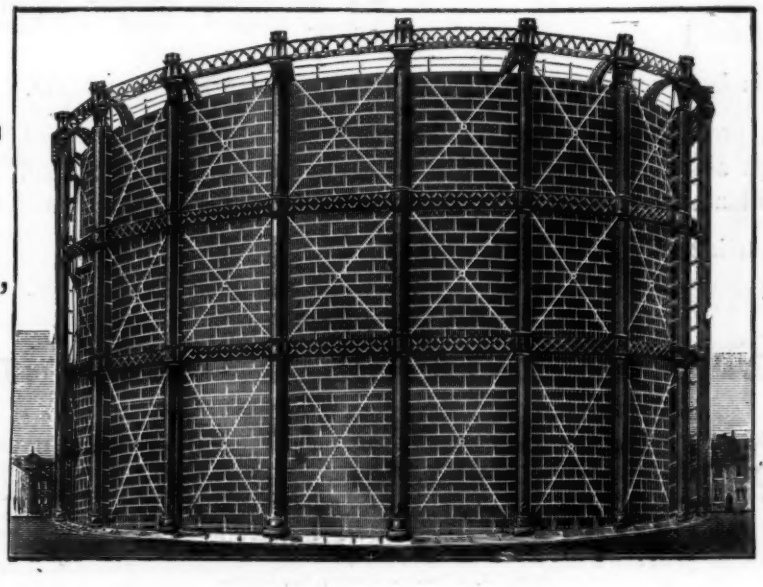

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The Oven is splendidly ventilated, and provided with an efficient damper, which allows the heat to be retained long after the gas is turned off.

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OFFICE: 10, MAWSON'S CHAMBERS, DRANSGATE,
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[See also Advt., p. 934.

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